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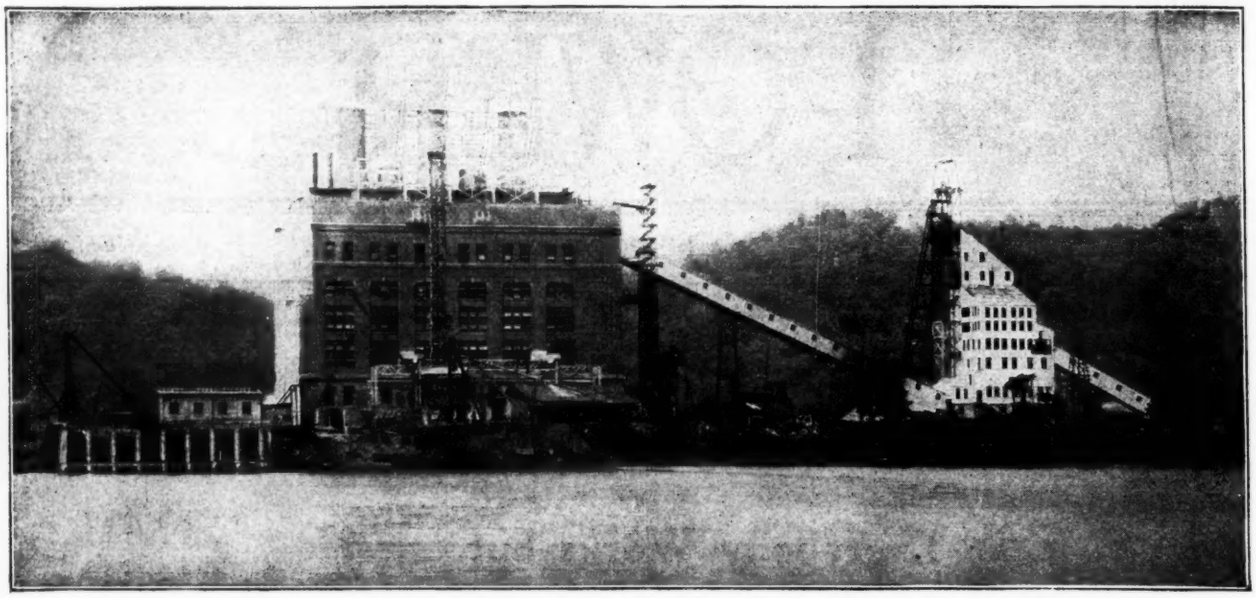
Everybody Works but ——?

THE almost universal shorter day resulting from reconstruction conditions finds the country no more depressed than when the hours of labor were reduced from sixteen to twelve and from twelve to ten per day.

Production per employee may have decreased but there are more people engaged in useful occupations and more labor saving methods. Hence, in the aggregate there is greater production per capita of population, notwithstanding scattered interruptions in certain industries which people are often too quick to regard as an index of general conditions.

Are the calamity howlers contributing their share of material production, or are they spending their time reading each other's essays?



Springdale Power Station, West Penn Power Company

By G. G. Bell
Manager Power Generating Department

THE West Penn Power Co. serves seven counties in the southwest part of Pennsylvania. The territory served is about one hundred miles long and has an extreme width of ninety miles. This territory centers around Pittsburgh, which, together with the greater part of Allegheny and all of Beaver County, is served by the Duquesne Light Co. The West Penn also serves the Panhandle district of West Virginia from a point about ten miles north of the city of Wheeling. The territory served includes the great coal-producing fields of western Pennsylvania, and the power company's largest customers are the coal companies. There are about four hundred mines connected, one company having 33 mines and a monthly consumption of 2,800,000 kilowatt-hours. Next in importance to the coal mines are the steel mills, particularly the steel furnaces. There are 70 furnaces, ranging in capacity from very small to those of ten-ton capacity having a gross demand of 25,000 to 30,000 kilowatts.

The generating equipment consists of two 25,000-kva. turbo-generators. Eight double-end stokered boilers are arranged in two rows, each equipped with 13-retort stokers. Boilers are designed for 350-lb. pressure and will be operated at a maximum of 250 to 300 per cent. Coal is delivered directly from the company's mine to the bunker in the boiler house after passing through a tipple where it is screened, picked and crushed. Fans are driven by alternating-current brush-shifting motors with direct-current characteristics. Ashes fall into tank filled with water from which they are removed by a crane-operated bucket. Condensing circulating water arranged for recirculating during winter months to prevent ice formation. By the adoption of a 2,500-kw., house turbine, 19 auxiliary turbines and 14 reduction gears have been eliminated.

The company has grown out of the amalgamation of fifty-seven companies serving individual small groups of communities. At the present time the company is operating nine steam, two water-power and two gas-engine stations. With the exception of two these stations are small and inefficient and will be shut down as soon as the capacity is available to take care of the load. The main source of power is the Connellsville power station, which is 60,000-kw. maximum capacity and is located in the center of the Connellsville coke region. The construction of this plant began in 1902. Three 1,000-kw. vertical engines, 25 cycle, were installed at that time and seven turbines ranging in size from 1,000 to two units of 18,000 kw. capacity have since been installed. In addition to these the West Penn Power Co. also runs 30,000 kw. of the capacity of the Windsor station. This is a modern station, having four 30,000-kw. units and sixteen boilers. The original installation was described in the Feb. 12 and Feb. 26, 1918, issues of *Power*. The two major sources of power at present are located in the southeastern and western sections of the company's territory.

The outstanding feature of the policy of the West Penn Power Co. is its acquisition and operation of coal fields in connection with its power houses. The owners

of the Windsor power houses have 11,000 acres of Pittsburgh coal, having an average workable height of 58 in., or a total of about 60,000,000 tons. This is sufficient to last the plant for one hundred years at its present rate of consumption, or, as the plant is laid out for an ultimate capacity of 250,000 kw., the life of the coal field will be between fifty and sixty years.

For a long time the growth in the Allegheny Valley district has been hindered by lack of proper power-generating facilities. In 1917 two 25,000-kw. units were contracted for; but on account of war financing conditions, the construction of the power house was held up until the fall of 1918, when a contract was closed with the United States Government for the erection of these two units on the basis that the Government would advance 40 per cent of the cost of the power house and of a few main transmission lines which were necessary to tie the power house into the present 27,000-volt transmission system, the total cost of which was then estimated to be $6,000,000. The contract called for a valuation three years after the close of the war as declared by proclamation of the President, and required the return to the Government of the difference betwen the 60 per cent invested by the company and the appraised value of the plant at that time.

The company had previously secured a power-house site near Freeport and had options on a large acreage of the thin coal in that district. However, on the advice of its consulting engineer, S. A. Taylor, negotiations were entered into with the Y. & O. Coal Co. for the purchase of its block of 3,734 acres of twin-vein Freeport coal close to the town of New Kensington. This coal has an average thickness through the field of 7 ft. 5 in. as against 42 in. in the upper field; and the company was advised that the difference in the cost of mining would more than offset the increased capital cost of the thicker-vein coal. On approaching the owners of the tract of coal, it was found impossible to purchase the coal, so a lease of the coal acreage was concluded, calling for an initial rate of mining of 200,000 tons per year, to increase in twelve years to 750,000 tons, which minimum is to continue until the field is exhausted. This will provide in excess of 50 years' coal supply for a power house of 150,000 to 200,000 kw. capacity. Fig. 1 shows a general plan of the Springdale power plant and mine section.

The company was fortunate in securing one of the last large tracts of land available for manufacturing purposes on the Allegheny River. The tract was of 83 acres and was covered with about seventeen feet of silt, below which is about 50 feet of gravel overlying the rock formation. In addition, the ground is low-lying, according considerable ash storage. The site is served by the Conemaugh Division of the Pennsylvania R.R. and by the Allegheny Valley Street Railway Co., an affiliated company of the power company, which provides street-car service up and down the river from this point. The site is within two miles of New Kensington.

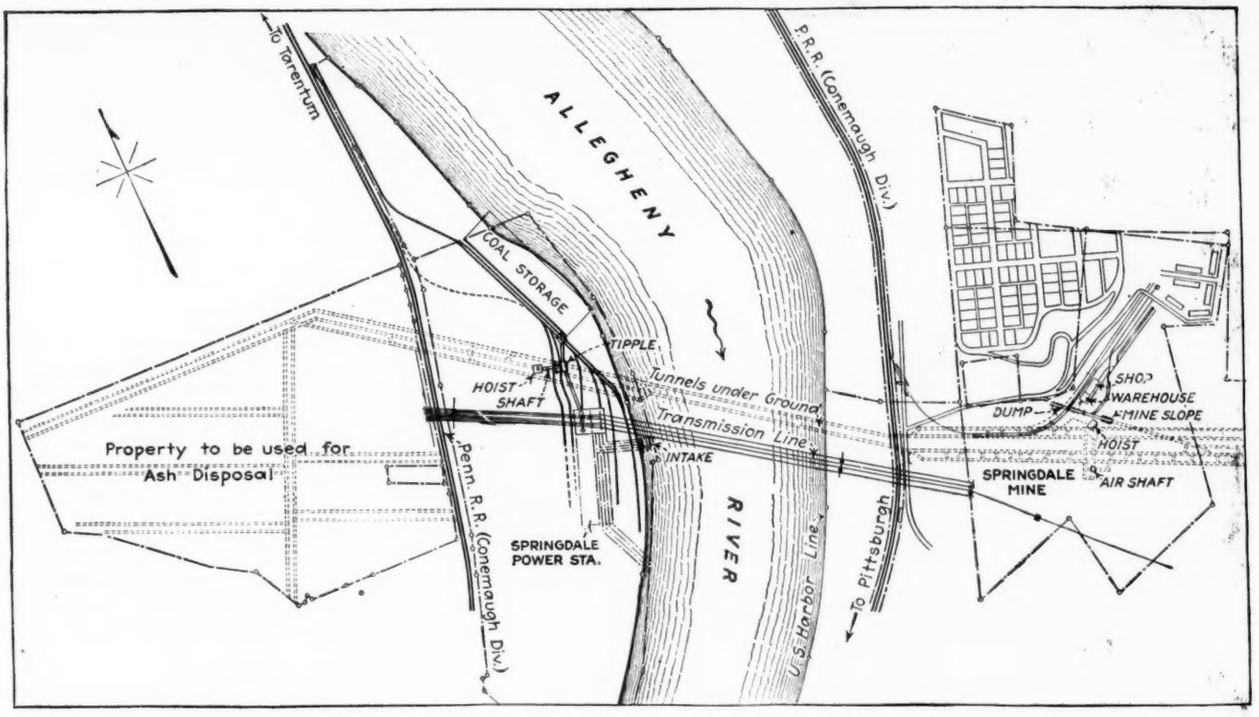


FIG. 1. GENERAL PLAN OF SPRINGDALE PLANT SITE AND MINE LOCATION

The drainage area of the Allegheny River at this point is about 11,500 square miles. The minimum flow is about 900 cu.ft. per sec., which, without recirculation, should be good for a plant of 250,000 or 300,000 kw. capacity. At this point the Allegheny River has a maximum rise of about thirty-two feet. The turbine-room floors are 7 ft. above the highest flood on record. By increasing the height of the light wells an additional three feet protection can be obtained.

Fig. 1 shows the relation of the mine to the power house, the tunnels and present mine development being in dotted lines. The coal is 90 ft. below the river, and tunnels are being driven in and below the coal to transport the coal from the mine to the power house. A typical section of the Freeport coal has a total

height of 7 ft. 5 in. About 4 ft. 6 in. from the bottom occurs a 10-in. band of a high-ash coal. Analysis of this coal shows about 10,000 B.t.u. and about 30 to 35 per cent cent ash. The fusing point of the average ash in the coal is 2,500 deg. F., and that of the ash in the bone coal alone is about 2,600 deg. F. The coal is covered by a carbonaceous slate, having a heating value of about 8,000 B.t.u. This is left up as a roof.

A typical analysis of the coal excluding the 10 in. of high-ash coal is as follows: Moisture, 91 per cent; volatile matter, 33.35 per cent; fixed carbon, 56.06 per cent; ash, 9.68 per cent; total, 100 per cent. Sulphur, 0.79 per cent; phosphorus, 0.036 per cent; B.t.u. dry basis, determined by bomb calorimeter, 13,866. Including the high-ash band the B.t.u. would be reduced to 13,250, but the average fusing point of the ash would be increased about 30 deg. and the percentage of ash in the coal would be increased to 12.2 per cent.

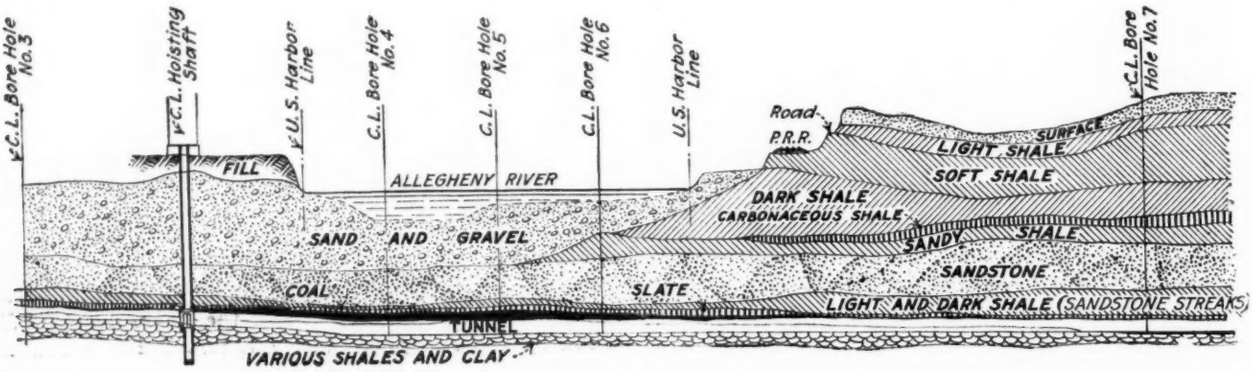


FIG. 2. PROFILE SHOWING STRATA ABOVE PROPOSED RIVER TUNNELS

Above the carbonaceous slate is a bed of sandstone, about 25 ft. thick, above which is a thick bed of gravel. Extensive drillings have been made in the river. These are plotted on the diagram shown by Fig. 2 and show that the thickness of coal and cover are uniform, with the exception of a thinning of the coal in the middle of the river. The sandstone, where it has been opened, is dense and of an amorphous structure, free from fractures; so little trouble is expected from leakage under the river. However, in driving the headings, drill holes are being driven 75 ft. ahead of the workings to explore for possible fractures, and arrangements are being made to use air in case trouble is encountered.

By moving the tipple one-half mile from the edge of the coal field to the power house, freight is eliminated. This item amounts with the increase in rates to at least $420,000 per year per 100,000 kw. of capacity; so that freight for a plant of 300,000 kw. capacity would amount to $1,260,000. In addition, most of the mines in the immediate neighborhood will be exhausted in a period of fifteen or twenty-five years; so that for the coal required after that time a higher rate would have to be paid.

Other advantages of a utility owning its own coal or being located close to the mines are that it is then free from the effects of strikes on the railway; and that the coal is delivered at a more or less uniform price, which is an important matter, as it is difficult for a utility to change its rates with increasing costs and particularly with a fluctuating coal market.

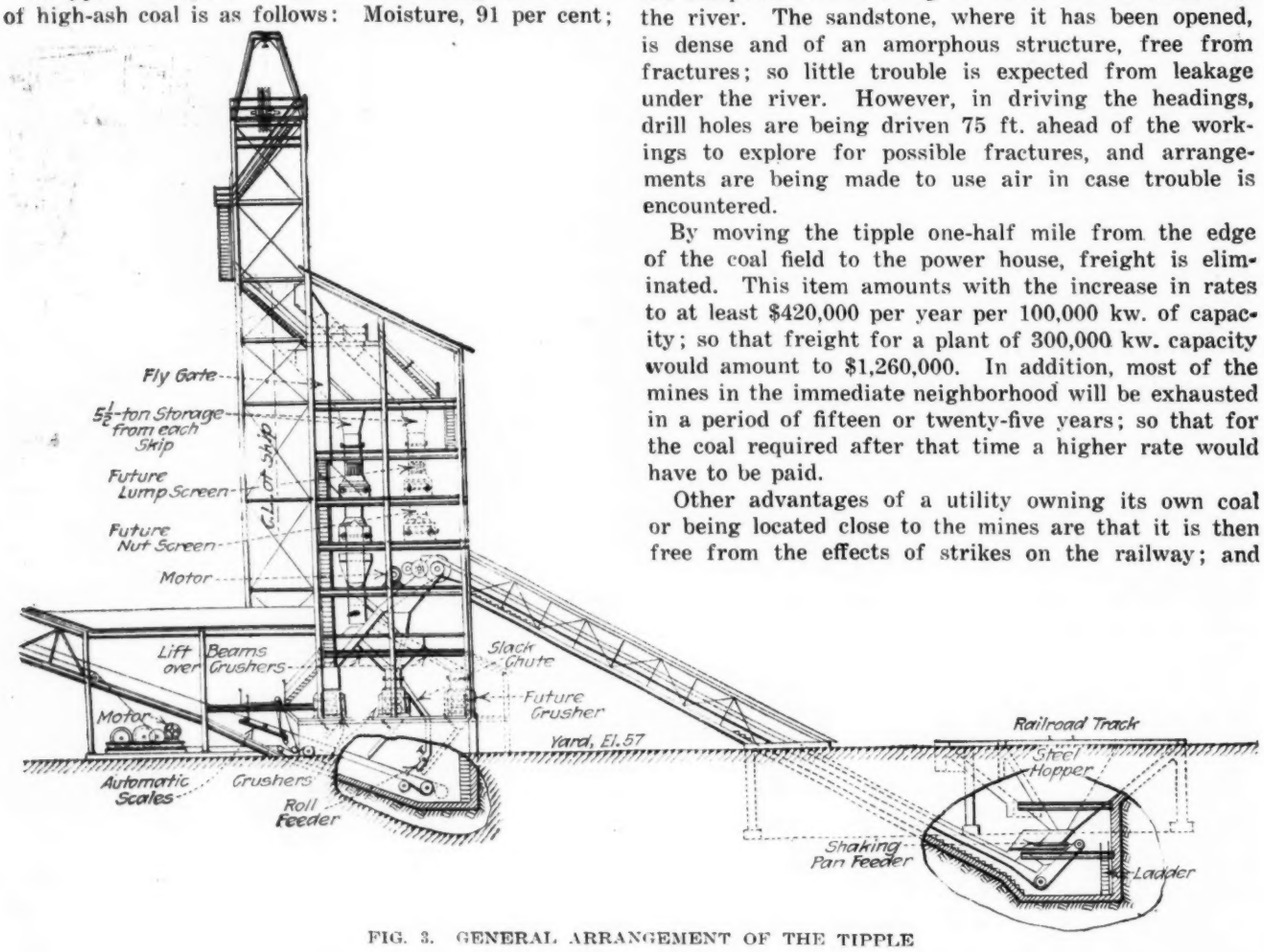


FIG. 3. GENERAL ARRANGEMENT OF THE TIPPLE

The most economical results in operation demand that the firemen be supplied continuously with the same type of coal, preferably of a high grade, as stoker adjustments depend upon experiment and experience, and it takes considerable time to make these adjustments. The coal received from the mine at Springdale will be of a constant grade and of a superior quality.

Thick- Versus Thin-Vein Coal

During the war the Government placed a differential of 60 cents a ton in favor of coal mined in the thin-vein district, with a price of $2.95 for this coal instead of $2.35 as for the thick-vein coal.

Another matter affecting the selection of the thick-vein site over that in the thin vein was the matter of mine-car capacity. Car capacities in the thin vein are small; probably 1¼ to 1½ ton capacity would be an average-sized car which could be used in the 42-in. vein. This would mean that, including 10 per cent for rock, 2,400 cars would have to be handled each day, or 400 an hour, which would mean a 30-car trip arriving at the shaft bottom every 4½ minutes. This requires a very high state of organization and would probably mean a double opening.

The power-house tract includes 80 acres of level land having an average elevation of about 5 feet above the pool level, or 20 ft. under the yard level. A yard level of from 4 to 6 ft. above high-water mark is being established. This should furnish sufficient ash and rock disposal to burn at least 10,000,000 tons of coal. There is a ravine back of the power house, which can be filled to a depth of 200 ft. and will furnish sufficient additional refuse storage to take care of the entire field of coal.

The privilege of dumping ashes on the tracts of ground in the neighborhood of the plant is bringing as much as 15 cents a ton at the present time. The railways have charged 80 cents a ton on the old rate schedules for disposing of refuse, so the ash-disposal privileges controlled by the company are valuable.

On the general ground plan is shown a yard about 250 ft. in width extending between the railway track system and the river. This tract is from 1,000 to 1,500 ft. long and will provide the coal storage for the plant. It is intended ultimately to place a coal-handling bridge over this yard, the bridge being so designed that coal can be loaded from railway cars or from the river into storage and from storage to a belt conveyor handling the coal to railway track hopper. The practice of the West Penn Power Co. is to store sixty days' requirements. The initial storage will be 50,000 tons and ultimately four to five times this amount.

The sources of coal supply for the power station are: First, the mine, which is laid out for a capacity of 3,000 tons a day; second, the railway, for which a double-track hopper is provided on which a rotary dump for railroad cars can be placed if advisable; third, from storage; and fourth, river coal.

Mine Equipment—Arrangements for Cleaning Coal

Mine cars will have an average capacity of from three to four tons, and will be of the solid-end type. Two will be placed at a time in an electrically operated rotary dump, the coal being dumped into an upper and a lower chute from which, by opening a double gate, it is discharged into a double-pocket Lepley-type skip, one pocket being above the other. There are two tandem skips, the empty partly balancing the loaded one. When the skips are raised to the top of the tipple, the two pockets in the skip each discharge on separate picking tables. The coal is then separated by a screen, the lump passing over an upper picking table, the coal under 4 in. passing over the lower table, the slack being placed in the center and the nut lumps on the side, permitting of further picking if advisable. The coal is then discharged from the double table into a common weigh basket, the coal to be crushed being placed in one pocket and the slack in a separate pocket. From the weigh pan the coal can be delivered either to the power house or to railway cars, the tipple being

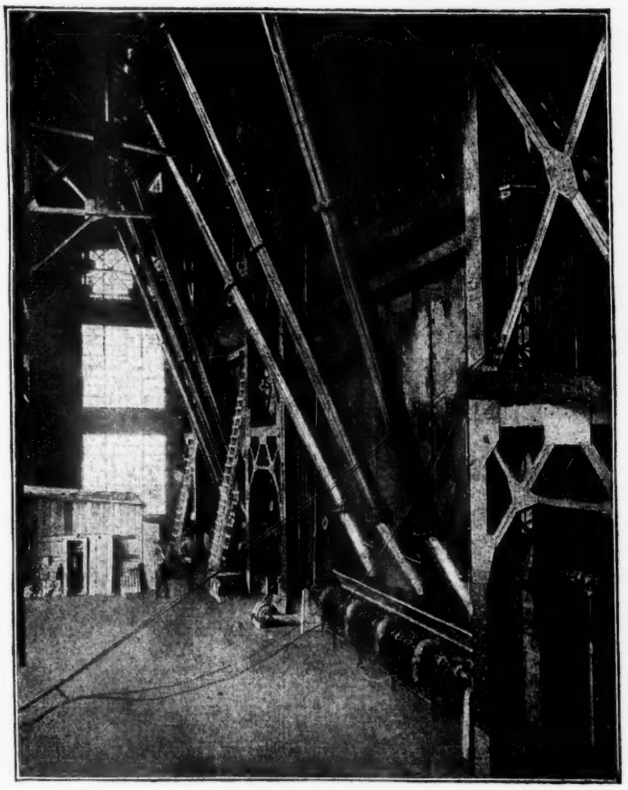


FIG. 4. PARTIAL VIEW OF BOILER ROOM

so arranged that either run-of-mine, lump or slack can be loaded out, the remainder of the coal being delivered to the power house. At the present time only one picking table is installed, so the initial capacity of the coal-handling apparatus will be 250 tons an hour. Fig. 3 shows the general arrangement of the tipple.

The lump coal to the power house passes through three crushers, any two of which have sufficient capacity to handle the output of the mine. The coal is elevated to the power house by means of a 42 in. belt having an ultimate capacity of 500 tons per hour, the slack being fed to the belt first and the crushed coal dropped on top of it, thus reducing the wear on the belt.

Coal received by railroad or from storage is dumped into a double-track hopper 32 x 40 ft., the coal being fed on to a pan conveyor having a capacity of 500 tons an hour and delivered to any of the three crushers.

Where it is desired to handle river coal directly to the power house, it will be unloaded by a coal bridge

directly into this track hopper, and from there through the crushers to the power house.

At the top end of the belt elevator the coal is either discharged directly into the large center bunker of the power house or fed to either of two conveyors running along the end of the power house, which deliver the coal in turn to the belts over the side bunkers. These latter five belts have a capacity of 250 tons an hour each.

The bunkers are of the suspension type, lined with concrete. Their capacity is about 800 tons per boiler,

There are two rows of boilers in the plant, Fig. 4, arranged with a large central overhead coal bunker and a smaller one on each side. Each boiler is equipped with two 13-retort underfeed stokers, the coal being fed by three 16-in. spouts on each end of the boiler. The spouts are staggered so that the boiler tubes can be pulled either on the front or on the back of the boiler without moving the spouts. The boilers are of the cross-drum type, 16 tubes high, built for a pressure of 350 lb., and stokered so that with an average grade of coal having about 10 per cent ash they can deliver

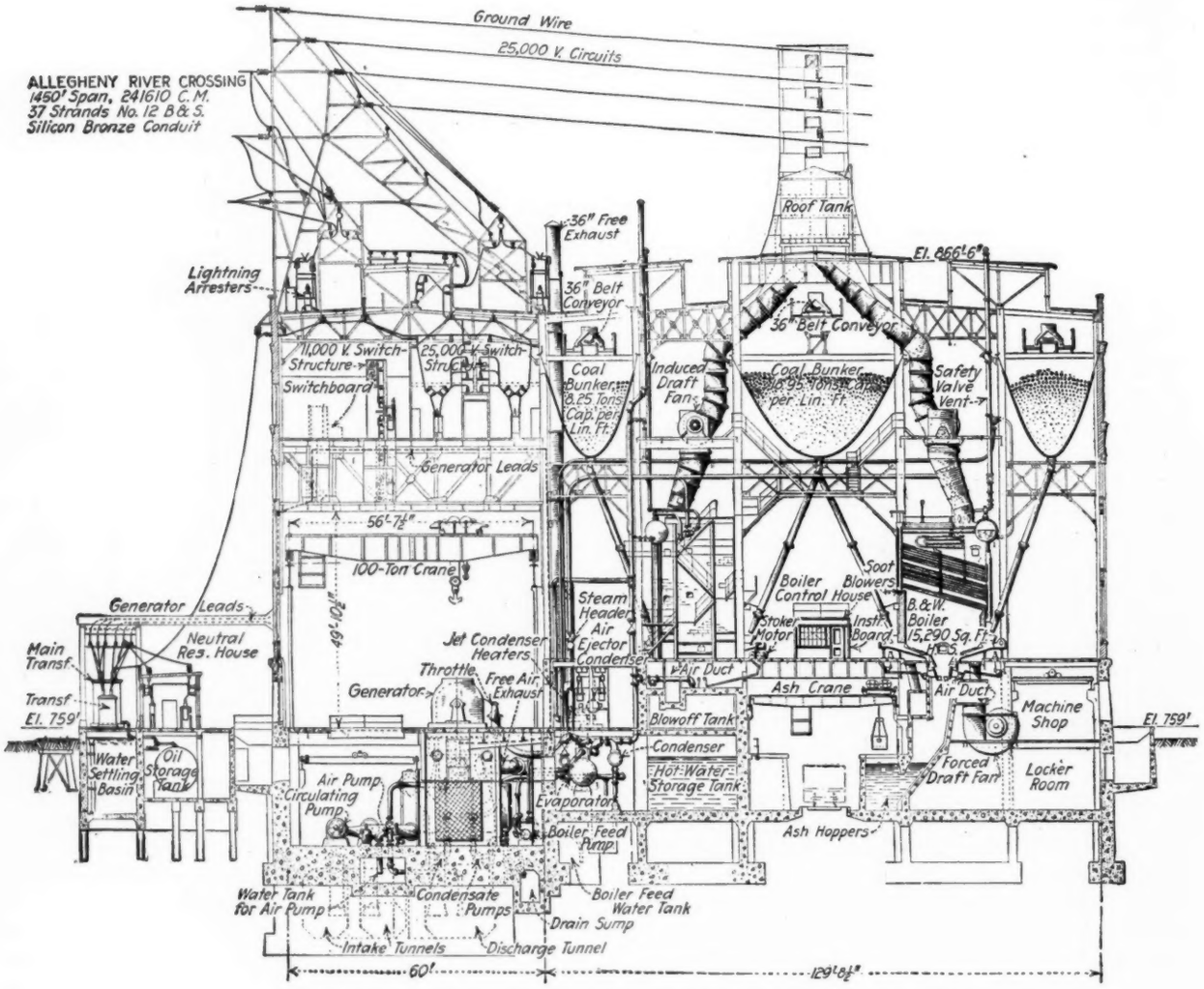


FIG. 5. CROSS-SECTION THROUGH BOILER AND TURBINE ROOMS

or about five days' supply for the plant when running under ordinary conditions. By reducing the load factor on the plant and conserving coal in the bunkers, the plant could probably run ten days on its bunker coal. At the end of the 42-in. inclined conveyor is a sampler crusher, which takes a continuous sample of the coal being delivered to the power house and crushes it, retaining it for analysis if desired.

The coal to the power house is measured as received from the miner, or on a weightometer on the 42-in. inclined belt. Coal to the individual boilers is measured by stoker counters. While not so accurate as the individual weighing devices, it is much simpler and less expensive to maintain. The bunkers will be screened off from the boiler room to reduce noise and dust.

a maximum of 185,000 lb. of steam per hour. Under these conditions the drop through the superheater and dry pipes is 25 lb. and the superheat is 235 degrees. Fig. 5 shows a cross-section through the boiler and turbine rooms. Each boiler contains 15,290 sq. ft. of heating surface.

The boilers are equipped with soot blowers, having nine elements on each side. One element is placed under the bottom row of tubes near the front header, and another just above the two lower rows of tubes near the baffle, so as to remove the slag from the bottom of the first pass. Elements placed in these locations are in use in the boilers in the company's other plants and have done a great deal to lengthen the periods between cleaning on Stirling boilers at the Connellsville plant. The

installation of soot-blower elements in the corresponding locations lengthens the period of actual service of the boiler 300 per cent, it being necessary, without this soot-blower arrangement, to take the boilers off once a week to have the tubes scraped, and only once a month with the elements installed as outlined. The life of these elements depends on the proper protection. The practice in vogue in West Penn plants is to place the soot-blower element in a brick or a tile pocket, permitting air from the forced-draft system to blow through and cool the element, except when the tubes are being cleaned; under the latter condition the pressure of the steam closes the check valve. The experience of the West Penn is that the proper protection and cooling of these two units is of much more importance than the material of which the blower is made.

Platforms are being provided, giving accessibility to the various inspection holes and valves. The boilers are covered on the front, back and top with steel plate, but the side walls are not covered. The boilers are wide enough for a 14-retort stoker, but one retort was eliminated in order to thicken the walls at the bottom 11 in., thus giving a 32½-in. brick wall at the bottom and a 21½-in. wall at the top.

The stoker is divided into four sections. Three steel plates are placed in the wind box under the stoker,

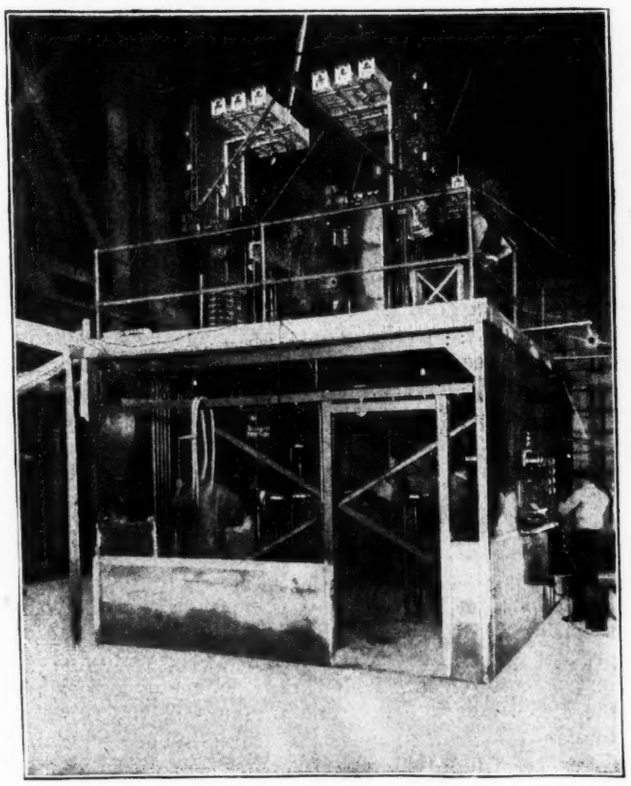


FIG. 6. BOILER-ROOM MOTOR CONTROL ROOM INSTRUMENT BOARD

separating the wind box into corresponding divisions. Each section has its own air supply and valve, so the air admitted to any of the eight sections into which the stoker is divided can be regulated. The stoker is provided with a double clinker grinder similar to that in use in several other plants, the manufacturer guaranteeing that the coke in the ash shall not exceed 14 per cent.

The stoker on each side of the boiler is driven by a double-speed a.c. motor of the pole-changing type, a maximum range in speed of from 25 per cent to full speed being obtainable. The two motors are regulated by a double controller worked by a single pilot motor

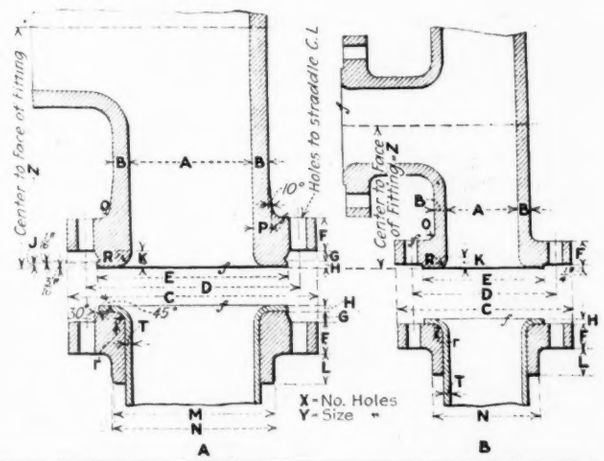


Fig.	Size	O.D. of Pipe	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	r	X	Y	Z	T
A	14	15.00	15¾	1¾	25½	22¼	20⅜	2¾	15/16	½	¼	1⅜	2⅝	17⅜	17⅞	13/16	2⅝	1½	⅞	20	1½	22½	0.500
B	8	8.625	7¾	1/16	16½	15¾	11¾	2⅛		3/16		1⅜	2⅛		10¾	9/16		1¼	¾	12	1¼	13½	0.500

FIG. 7. DETAILS OF 400-LB. STEAM- AND WATER-PRESSURE FLANGES AND FITTINGS

and arranged so that either stoker may be set a maximum of two notches ahead of the other.

Each boiler has its own forced-draft fan. These fans take the air from the generator discharge on the turbine side of the boiler room, getting what additional air they require from a duct running between the turbines to the east wall of the turbine room. The air for the fans on the west side comes in through the lower basement windows under the machine-shop floor. The air is forced by the fan into a duct supplying both sets of stokers under the boiler. The ducts for the various boilers are separated by dampers, which can be opened in case of failure of any of the forced-draft fans, thus providing breakdown capacity. They have a maximum capacity of 105,000 cu.ft. of air a minute at 7 in. pressure, sufficient to operate the boilers at 450 per cent rating. The fans are driven by a.c. brush-shifting motors with d.c. characteristics.

The boilers will ordinarily be operated at a maximum of from 300 to 350 per cent, and the average will be 200 to 250 per cent. The losses at these partial loads for the straight a.c. motor are excessive; although this can be partly overcome by using two motors. The brush-shifting motor, however, is more efficient and has considerable advantage where automatic regulation is contemplated. The efficiency, for instance, at 250 per cent rating of the boiler is estimated at 47½ per cent for the slip-ring motor, as against 80 per cent for the brush-shifting motor. These motors are of 175-hp. capacity, and curves indicated that there was an average reduction in the losses of 21 kw. by using the brush-shifting motor.

Each boiler is equipped with two single fans with two motors, one of 175-hp. and one of 400-hp. capacity, the whole set being interconnected by flexible couplings.

Ordinarily, the two fans will be driven by the 175-hp. motor, which has sufficient capacity to operate the boilers at 300 to 350 per cent rating. If it is desired to have more draft than can be furnished by the smaller motor, the 400-hp. motor is brought up to speed, the magnetic clutch closed, and the current supplied to the 175-hp. motor is disconnected, its rotor being turned by the larger motor. With this combination, in case of any one unit going down, considerable capacity can still be obtained from the boilers. Either half of this unit will operate the boiler up to 300 per cent rating, but not so efficiently as the two fans will together.

The induced-draft fans are located on a concrete platform some distance above the boiler, there being sufficient space between the boiler and the induced-draft fan to permit of the installition of an economizer. The

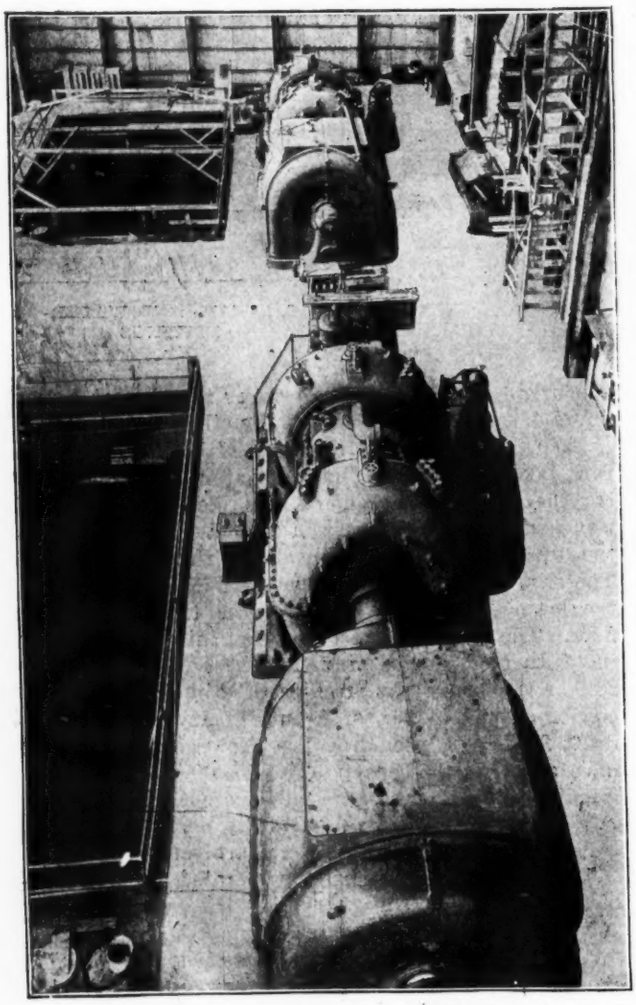


FIG. 8. VIEW OF THE TWO 25,000-KV.-A. TURBO-GENERATORS

characteristics of the fan are such that with the cooler gases that would be obtained from an economizer, they will operate the boilers at the same rating. The maximum draft required to operate the boilers at 400 per cent rating is 5 in.; with economizers this would be increased to 7 in. Flues and fans are lined with Vitrobestos.

The controls for the stoker and two 175-hp. fan motors are of the clapper type, the dials being operated by pilot motors controlled either by hand or automatically. The 400-hp. induced-draft fan motors are arranged to operate by hand only; the automatic regulation and then be on stoker and forced-draft fans only.

In order to eliminate the vapor rising from water leakage from the ash hopper gates, gases rising from the quenched ashes and shooting flames from the ash-pit doors, due to the air pressure, an ash-handling sys-

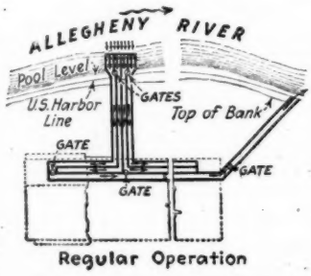


FIG. 9. NORMAL OPERATIONS OF INTAKE AND DISCHARGE SYSTEM

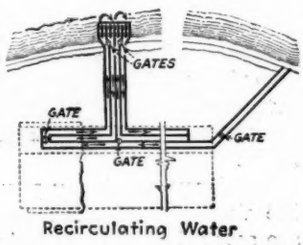


FIG. 10. WATER BEING RECIRCULATED THROUGH TWO OF THE INLET TUNNELS

tem, modeled after that installed at the power house of the Kansas City Power and Light Co., has been installed. It is modified, however, in that there are two ash-handling galleries in that plant, whereas in the Springdale plant both rows of boilers discharge to a single gallery, so that a single railroad track and crane runway handle the ashes. The ashes in falling from the boilers drop into a large tank of water, are immediately quenched and fall to the bottom of the pit. Sprays are placed at the elevation of the stokers, so that with the large pocket above the clinker grinders, the ashes and clinkers should be dead before being discharged by the clinker grinders. Doors are provided to give access to the chute to remove clinker in case the ashes bridge in the chutes. One crane operator with a train crew of two men will handle the entire ash output from the plant. A continuous cableway system can be run through the ash tunnel and loaded by the crane, at a very slight expense for modifications. The ashes can also be dredged out by a centrifugal pump and delivered by a pipe line in an emergency.

The control for the four boilers is centered in a room in the main firing aisle of the boiler room, Fig. 6. The switches controlling the supply of current to the various motors are inside the room, and the instruments and controls for the motors for four of the boilers are on the outside. The piping will all be in the inside of the room, which will be steam-heated, to prevent freezing of the instruments in winter. The instruments for each boiler are boiler meters, recording the steam flow, air flow and pressure in the furnace; four-in-one draft gages and three-in-one recording gages, recording the steam temperatures and pressures, degree of superheat, etc. The stoker and fan motors are arranged for automatic boiler control.

The steam piping is of steel, with Van Stone welded flanges; the hot-water piping, of wrought iron with welded flanges. On account of the high-pressure the 800-lb. hydraulic flange was adopted for steam and water piping. The flanges on the steam piping were modified to permit of welded joinings. Fig. 7 shows details of the 400-lb. steam- and water-pressure flanges and fittings.

On account of the auxiliaries being motor driven, the amount of small steam piping is practically negligible. The total cost of the steam piping in place, covered, will not exceed 1 per cent of the cost of the plant; and the total piping contract, about 3 per cent of the cost of the plant.

The steam piping is covered with a 3-in. covering of Nonpareil. This is to be covered with a couple of turns of building paper and a final covering of 8-oz. canvas sewed on, the canvas to be given two coats of paint. Where steam pipes are exposed to injury, they are to be covered with sheet metal.

The boilers are equipped with feed-water regulators and boiler-feed pump governors. On the motor-driven unit the feed-pump governor acts as an excess-pressure reducing valve. All steam and water valves were tested to three times the working pressure.

The generating equipment of the turbine room consists of two 25,000 kva. Westinghouse generators, three-phase, 60-cycle, designed for a maximum of 12,000 volts, Fig. 8. The condensing equipment consists of a single 32,000-sq.ft. condenser per unit, having 1-in. tubes about 20 ft. long. The condensers are hung from the turbine foundation. On account of taking care of the longitudinal expansion of the turbine, copper expansion joints have to be provided between the condensers and the turbines. Large openings are left in the floor in front of the units, to light and ventilate the condenser pit. Windows are provided under the turbine-room floor. These are protected from high water by means of concrete areaways.

There are two motor-driven circulating pumps per unit, each having a capacity of 17,500 g.p.m. at the maximum head. Each pump, when run by itself, will furnish from 60 to 65 per cent of the amount of water that the two pumps together will furnish, on account of the reduced friction head. The condensate pumps are motor driven and in duplicate, each being of 100 per cent capacity. One Le Blanc air pump of 100 per cent capacity is provided, and two steam air ejectors are provided for use in case of excessive leakage or for breakdown service. Three different sources of water are supplied for the Le Blanc pump; First, directly from the river; second, in case of flood, from the tank if the discharge pressure on the Le Blanc is higher than it will work under successfully; third, from the circulating system, in case the dam located approximately one-half mile below the plant should fail, and the suction head on the pumps should become too large.

As the power for the motor-driven auxiliaries is supplied by a house turbine, and the exhaust steam from it is used to heat the feed-water, there is an advantage in the Le Blanc pump in that it requires less steam than the steam air ejectors. However, the cost of the tank and the complication of the piping and floor space required add considerably to the expense of the Le Blanc air pump. There is not much complication in the steam exhauster, provided the steam discharged into an open heater. This means a possible difficulty in getting proper air separation. Where jet condensers are used for heaters, as in the Springdale plant, and it is desired to reduce the amount of air in the condensate and makeup to a minimum, it is necessary to provide a surface condenser, into which the exhaust steam and air from the ejector are discharged. These gases are cooled by the condensate before it enters the heater. The additional cost of this surface condenser and the piping will offset the increased cost of the tank and piping required by the Le Blanc air pump.

The plant is located about half a mile above the Springdale dam. The intake tunnels are placed low enough to insure that the power house will be able to operate in case of failure of the dam, provided ten or twelve feet of gravel is dredged away from the intake. The main intake trouble is from ice and leaves. This is overcome by the installation of rotary screens

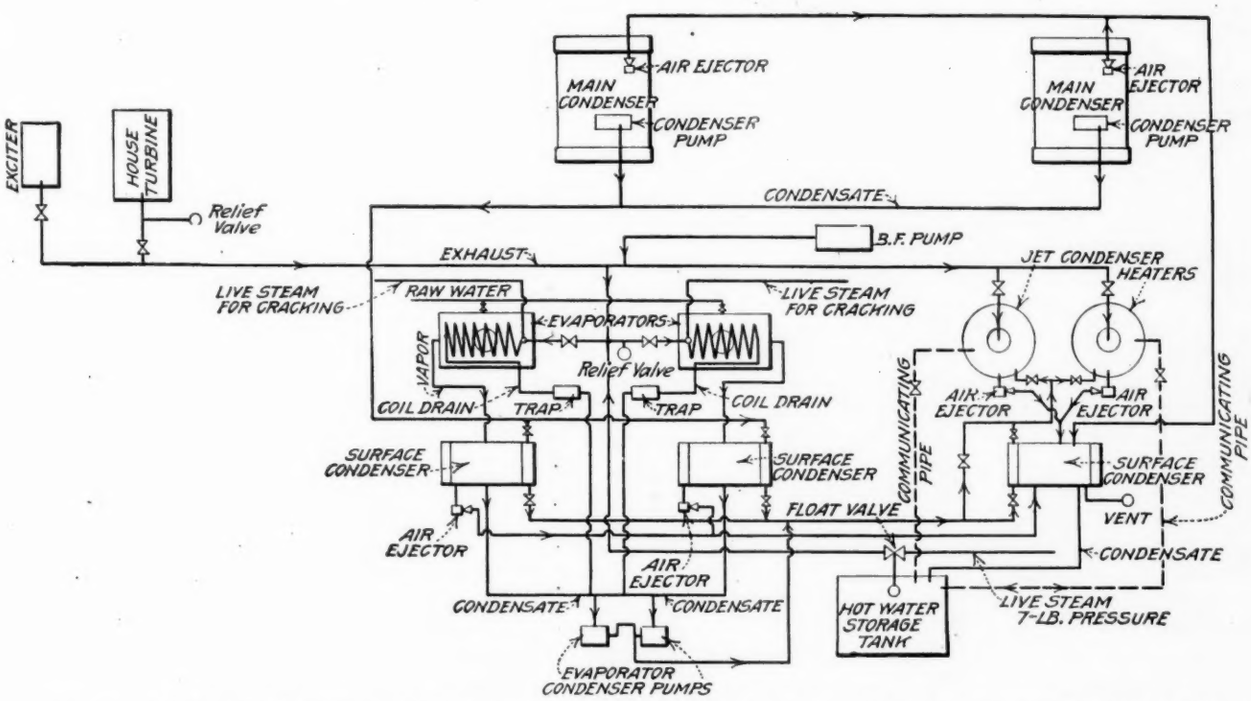


FIG. 11. ARRANGEMENT OF HOUSE TURBINE JET CONDENSER, HEATER, EVAPORATOR AND STORAGE TANK

and arrangements for recirculating the discharge water, permitting it to be cooled by the ice and recirculating it through the condensing system. A modification of this idea has been tried out at the Connellsville power station, and at one or two other power stations that are subjected to similar trouble; and it has been found satisfactory wherever tried. The rotary screens are of link-belt design. They are 6 ft. wide and arranged for motor drive, the top of the screens being above the maximum high water on record.

Figs. 9 and 10 show the arrangement of the intake and discharge system. Fig. 9 shows normal operation, and Fig. 10 shows the gate in the discharge tunnel closed and the water being recirculated through two of the four inlet tunnels. There are two tunnels supplying circulating water to each unit in the power station. One circulating pump on each unit gets its water supply from each of the two tunnels, so either tunnel may be shut down for repairs and still permit operation of all units at full or nearly full capacity. The double intake tunnel system and means of recirculating the water also has the advantages of permitting the cleaning of the condensers while in operation. One circulating pump can be shut down and the dirt from the condenser washed through it into the tunnel by a partial reversal of flow in the condensers.

Auxiliaries Are All Motor-Driven

All the auxiliaries in the plant, with the exception of one boiler-feed pump and one exciter set, are motor driven. The station was originally laid out with the intention of putting in dual drives, in order to maintain a heat balance. However, an investigation of the relative merits of turbine and motor drive, using a 2,500-kva. 2,200-volt house turbine to produce the power for the auxiliaries, showed that by adopting the house turbine, nineteen turbines ranging in size up to 400 hp. and fourteen reduction gears could be omitted, and that the initial cost was less for the house turbine; that is, when the dual drive for the more important units, such as circulating pumps, has been provided. The house turbine also increases the over-all economy of the station by 2 per cent, as it produces a kilowatt of power for from 50 to 60 per cent of the amount of steam that a small turbine would take, considering the increased steam consumption at part loads and at reduced speed on the smaller machines. There is at least an equal saving in the capacity of the large turbines, which would be required to supply power to the auxiliaries so that the net station capacity is increased.

In order to heat the condensate to 210 deg., it requires that about 13 per cent of the condensate be available as exhaust steam. The amount of power consumed by the auxiliaries at the Windsor power station is 5½ to 6 per cent of the total power generated; and the amount of power required by the Springdale units should be about the same percentage, as the house turbine requires 125 per cent more steam per kilowatt-hour than the large units do. This figure would indicate that about the correct amount of exhaust steam is available.

One of the chief sources of trouble to electrically driven auxiliaries is lightning or other surges on the line; and it has been customary in some stations to install motors of approximately 50 per cent excess capacity, in order that the motors might not kick off under such conditions. With a house turbine and dual auxiliaries and with a duplicate 2,200-volt bus system to feed the auxiliaries, the house turbine is connected to one bus, the other bus being connected to the large units through a bank of house-service transformers, and where there are duplicate auxiliaries, one is connected to each bus. In case of failure of either source of supply the other auxiliary continues to operate. If it is desired to keep a uniform feed-water temperature, the house turbine can be run parallel with the main units and the load on the house turbine controlled thermostatically, or the load can be transferred by hand from one bus to another in case the house turbine is run separately.

There is also the advantage of the house turbine that in case of a complete station interruption, the house turbine can be put on the line and be ready for service much quicker than one of the big units. A motor-driven auxiliary plant has the additional advantage that on account of the elimination of the leaks in steam piping and around the governors on the smaller units, the amount of makeup is much less. Data in this respect are limited, but practice in first-class plants seems to be about 2 per cent makeup in the motor-driven plant as against 6 per cent in the steam-driven.

Acid Conditions in the River

When the flow in the Allegheny River is very low, there are traces of acid. This probably will increase as manufacturing increases up the Allegheny Valley. To take care of the water requirements of the plant, a 1,000,000 gal. per day filtering system was provided. This was worked in at a comparatively small additional expense with the foundation of the transformer house. This water will be used in the lower service system to prevent corrosion of piping through the plant and cooling coils in transformers and turbines. The makeup for the boilers is taken from the same source and is evaporated in two horizontal evaporators that work between the pressure of the exhaust steam from the house turbine (two pounds) and a 23½-in. vacuum, which is about the highest vacuum that can be maintained in the evaporator when working at full capacity and using condensate from the main turbo-generators as cooling water. By this arrangement the condensate is heated to about 125 deg. F. in the evaporator condensers; and it is then given a final heating in two jet condensers. Both evaporators and jet condensers are provided with single-stage air exhausters to maintain a vacuum in the evaporator condensers and heater condenser, if desired. It also serves the purpose of extracting the air from the makeup and gives a water supply for the boilers that should as nearly as possible eliminate corrosion. This is particularly important where steel economizers are contemplated. As far as is known, this is the first application of the low-pressure evaporator for power-plant purposes, although they have been employed in the sugar and other industries extensively. It has the additional advantage that at the low temperature in the evaporator there is little tendency to form scale. An evaporator after being in service for six weeks at a little higher temperature than it will work under, upon examination was found free of scale, the only foreign matter being a fine powder on the walls and coils.

Fig. 11 shows an arrangement of the house turbine, jet condenser heaters, the evaporator and storage tank.

Rebabbitting Engine Parts—II

By H. HAMKENS
Consulting Engineer, Newton, New Jersey

BABBITTING a bearing on the shaft can, of course, be recommended only for an emergency. The proper way to do this is to use a mandrel of cast iron or steel instead of the shaft, according to the size. A piece of pipe screwed into a flange may answer the purpose, and after babbitting the bearing should be bored to fit the shaft. If the bearing consists of four boxes, the process will be as follows: The mandrel, which is usually a hollow casting provided with a flange, is set on end on the floor or bench, and the boxes, one at a time, are clamped to it, using wooden blocks and boards for distance pieces and for confining the metal. Fig. 13 shows a lower box clamped on a mandrel, the lower end of the box resting on the flange; a gate and riser are built on the top of the box, and the metal is poured in a steady stream. This method will prevent shrinkage holes, which are almost unavoidable on bearings of larger size, if the babbitt is poured with the boxes in a horizontal position. Instead of a mandrel a curved plate, as shown in Fig. 14, may be used; this does away with the wooden blocks. In these methods allowance must be made for boring the boxes. After the babbitt has been poured it is generally expanded in place by hammering, the object of this being to make the metal fit tightly all around the recesses and in the grooves. The metal is struck lightly with the ball end

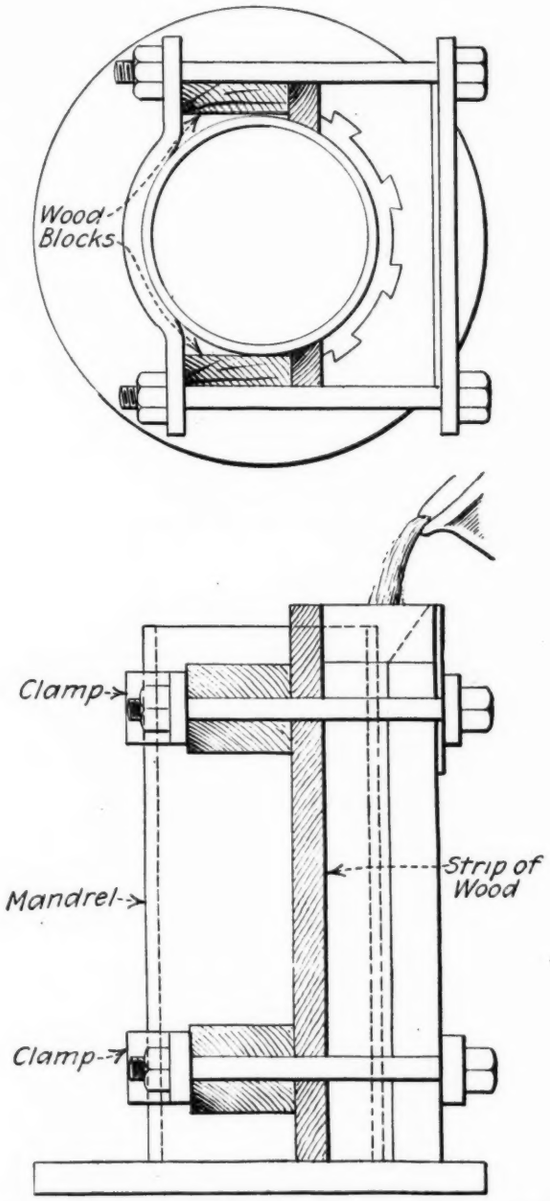


FIG. 13. THE BABBITT IS POURED INTO THE LOWER BOX, WHICH IS CLAMPED ON A MANDREL

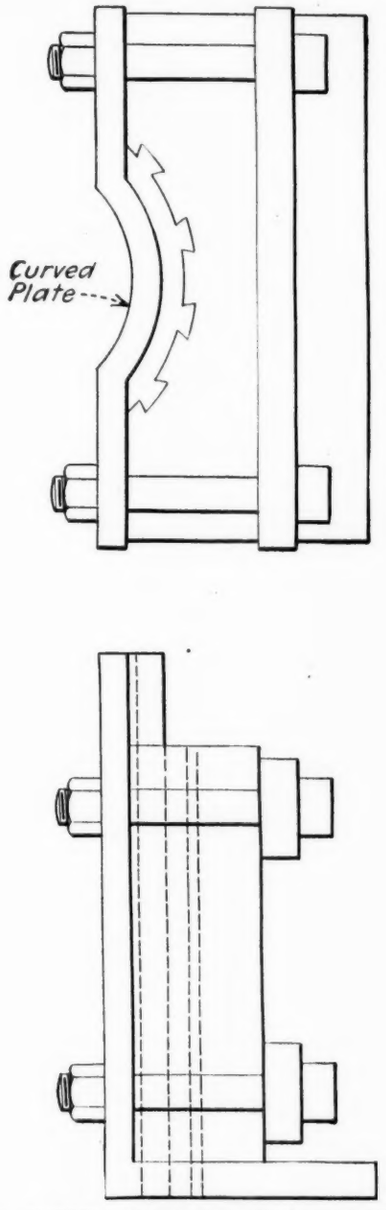


FIG. 14. CURVED PLATE FOR USE IN BABBITTING MAIN BEARING

of a hammer uniformly all over. The blows leave marks on the babbitt, as shown in Fig. 15. Care should be taken not to strike the metal too hard, otherwise it may become brittle and crack, especially at the edges.

The next operation will be the boring of the boxes, for which purpose they are clamped together. If no machinery is in the place, the work can be done by hand, provided a boring bar and some boxes are available. The bearing may be clamped down on a suitable plank, on which also the stands or boxes for the boring rig are fastened, as shown in Fig. 16. The bar is turned by means of a hand crank at one end, while the feeding is done at the other end with a screw and handwheel or a wrench.

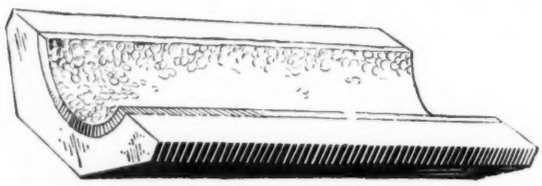


FIG. 15. BABBITT EXPANDED BY HAMMERING

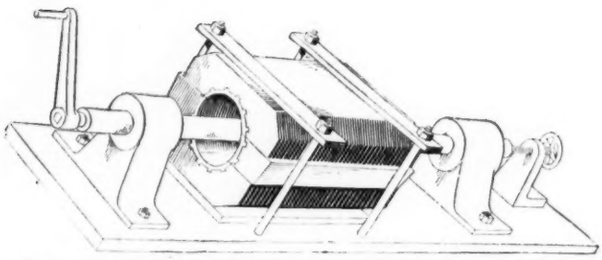


FIG. 16. HAND BORING MACHINE FOR BORING OUT BEARING BOXES

While the pressure in the main bearing rarely exceeds 150 lb. per sq.in., that in the crankpin boxes may run close to 1,000 lb., and for the crosshead-pin boxes pressures from 1,200 to 1,600 lb. are allowed. It is not wise to use babbitt linings for pressures much over 1,000 lb. per sq.in., as the metal will not stand such high pressure; it has a tendency to spread, even if extremely well secured. Some manufacturers make the crosshead pin of the same size as the crankpin and are, therefore, justified in using soft-metal lining; this is a great advantage, since it prevents the pin from getting scored in case of a hot-box. Genuine babbitt has been proved to be the best wearing material for these boxes, and no other should be used.

The same as in the main bearing, the crankpin boxes may be chambered for the lining as shown in Fig. 17-A, or the babbitt may run clear through as in Fig. 17-B. If the boxes are made of cast steel, it is essential that part of the faces should be babbitted to protect the boss on the crank or the crankpin washer from coming in contact with and getting cut by the hard metal of the boxes. This method is illustrated in Fig. 17-C.

In case of emergency the crankpin boxes may be rebabbitted directly on the crankpin. If the pin is overhung with a loose washer, as shown in Fig. 18, both halves can be babbitted at the same time, taken off and cut in two, but with a solid flange at the end or on a center crank each half must be babbitted separately. The better method, however, is to babbitt the boxes on a special mandrel with an allowance for boring.

The process of rebabbitting the boxes for a crosshead pin is simple. The boxes can be clamped between two suitable boards and placed over the pin, which is fitted into a hole cut in the lower board, as shown in Fig. 19. Strips of wood can be fitted in the slots of the boxes. Each half may be poured separately, or both halves can be cast together and cut in two afterward. For rebabbitting the boxes on old-time crossheads with solid pins, a mandrel must be used and the boxes must be bored to fit the pin, which is usually provided with large fillets.

The wear on the crossheads of horizontal engines running over is all on the lower shoes; if the engine runs under, there is also some wear on the upper shoes. The lower shoe, therefore, needs the principal attention. The pressure allowed on crosshead shoes should not be over 75 lb. per sq.in. An engineer can easily check the pressure on the crosshead shoe in the following manner: Multiply the area of the piston by the steam pressure and divide by the ratio of the length of the connecting rod from center to center to the stroke; the quotient divided by the projected area of the crosshead shoe will give the pressure per square inch. Take, for instance, a 16 by 36-in. engine with an initial pressure of 100 lb. per sq.in.; the maximum pressure on the piston will be $201 \times 100 = 20{,}100$ lb. This, divided by the ratio of

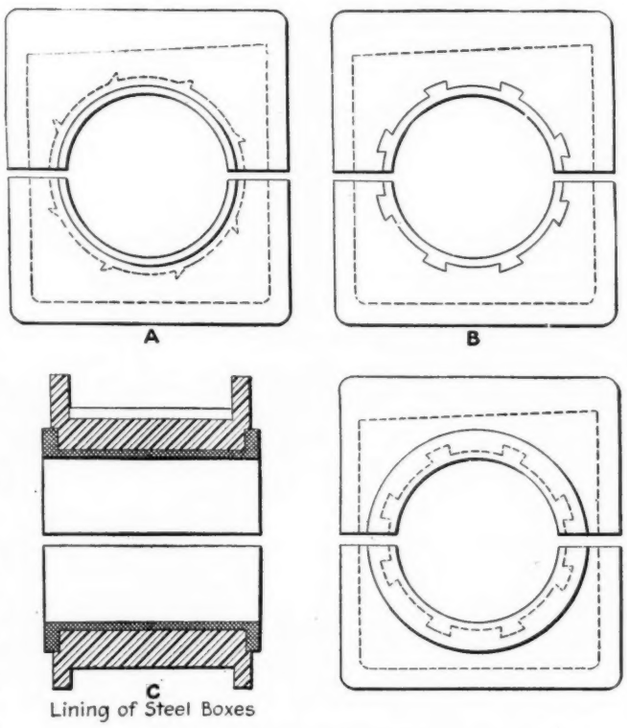


FIG. 17. BABBITT IN THE CRANKPIN BOX

connecting rod center to center to the stroke, which we will assume to be 3 to 1, will give $\frac{20{,}100}{3} = 6{,}700$ lb. as the maximum pressure on the shoe. Suppose the crosshead shoe to be 16 in. long by 6 in. wide, with a projected area of 96 sq.in.; the pressure per square inch will be $\frac{6{,}700}{96} = 69.8$ lb. This pressure will act on the shoe only when the engine is carrying a heavy overload; ordinarily, the pressure will not exceed one-half or perhaps two-thirds of the amount. From this

simple calculation we gather that it cannot be the pressure alone which will make the shoes wear; there must be another element which enters into the performance. This is the velocity with which the shoe moves over the guide. The material with which a crosshead shoe is lined can, therefore, be of different composition from that used in the bearings or connecting-rod brasses.

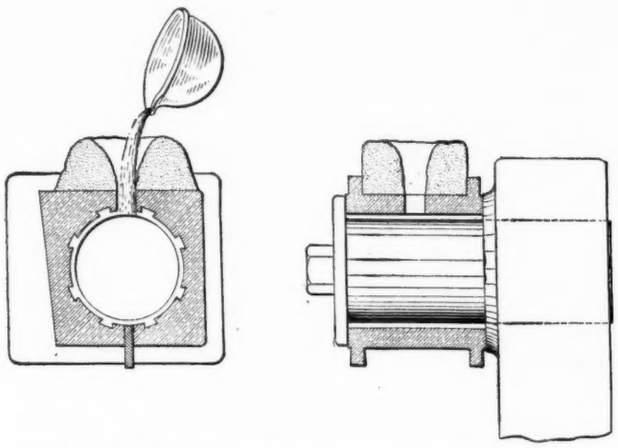


FIG. 18. BABBITTING THE CRANKPIN BOXES ON THE PIN

Lead and antimony in the proportion of 84 to 16 will make a good mixture for the purpose. The antimony with a melting point of 900 deg. must be melted first, and the lead, which melts at 600 deg., is added.

Some old-time crosshead shoes require frequent rebabbitting, owing to their limited area and disadvantageous shape; the V-shaped shoe is perhaps the most common among them. To rebabbitt one of these, a form

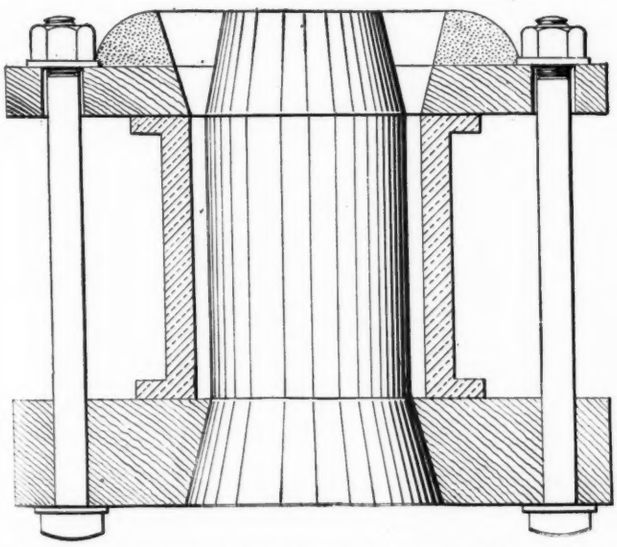
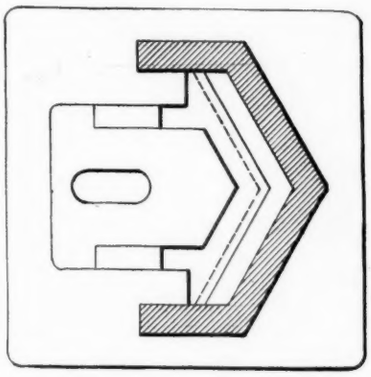


FIG. 19. CROSSHEAD PIN BOXES BABBITTED ON THE PIN

has to be made, to which the shoe is clamped with a proper allowance for the metal; the babbitt is poured with the shoe placed in a vertical position, as shown in Fig. 20. The form to which the shoe is clamped may be made of wood, but one of cast iron is to be preferred. Shoes for bored or flat guides can be rebabbitted in a similar manner. The babbitt, after being poured, is hammered lightly and then machined and scraped to a good bearing on the guide. To save the machine work, for which few engine rooms have the necessary outfit, the shoes can be rebabbitted in the guides by blocking up the crosshead as shown in Fig. 21. A form made of wooden blocks and strips is built around the shoe on the lower guide. With the proper gates and risers arranged to suit conditions, there is not much difficulty in



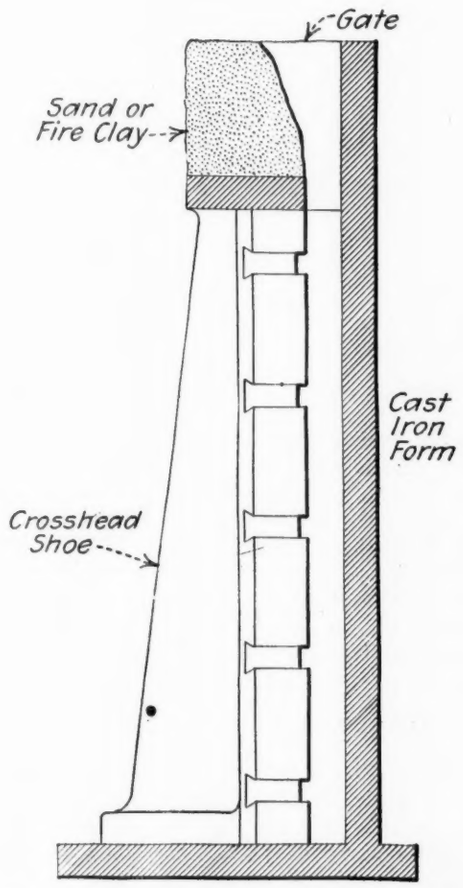


FIG. 20. BABBITTING THE CROSSHEAD SHOE

pouring in the metal, but there is a certain amount of danger in cracking the guide when the hot metal is poured onto it. It is strictly an emergency job, on which a man takes some chances.

The question whether a babbitted eccentric strap is to be preferred to one without soft-metal lining has never been definitely settled. A babbitted strap, how-

ever, will not cut the eccentric if it gets hot; and it will get hot occasionally in spite of the most perfect oiling devices and careful watching. If the eccentric is split and can be taken off, it can be used for babbitting. For that purpose it is mounted on a board into which a block of wood of the size of the shaft is fitted, as shown in Fig. 22. Two boards, one for the top and the other for the bottom, are located on the main board to hold the strap in place, which is also secured by wooden blocks on the outside of the rim. The gates for pouring the

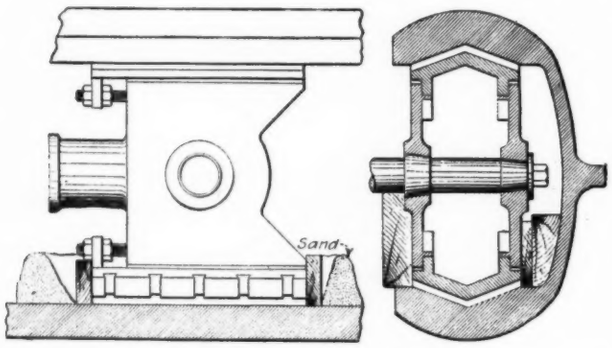


FIG. 21. REBABBITTING CROSSHEAD SHOE IN THE GUIDE

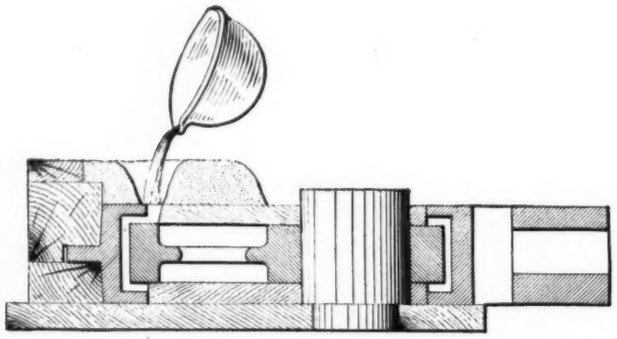


FIG. 22. BABBITTING THE ECCENTRIC STRAP

babbitt are made of fireclay or other suitable material. Each half of the strap is poured separately, and if the strap is of large size the metal must be poured in two places. Since the babbitt has to travel a considerable distance through a narrow space, it is in this case of prime importance that both eccentric and strap be well warmed. If the eccentric is solid and cannot be removed from the shaft, a dummy of wood may take its place for babbitting, with sufficient allowance for machining.

"The Story of Petroleum"

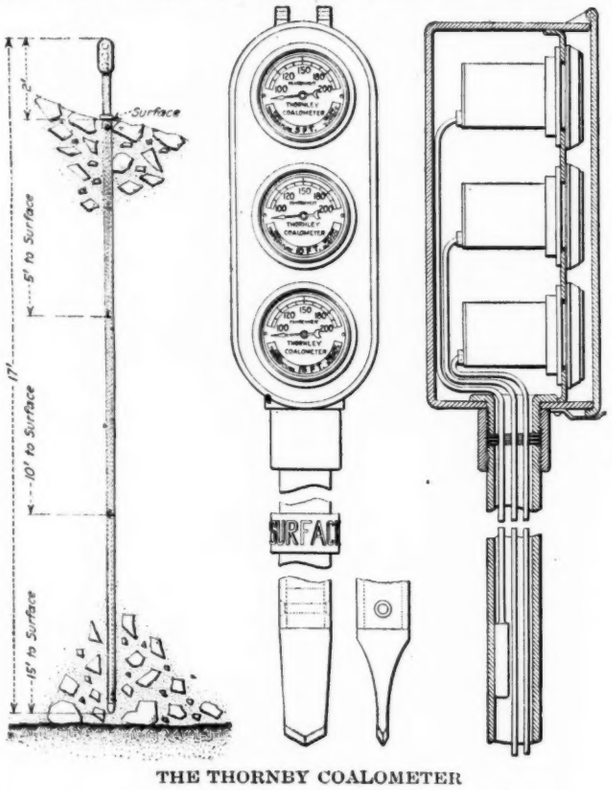
The United States Bureau of Mines in co-operation with the Sinclair Consolidated Oil Corporation has just completed a new four-reel motion picture film telling the complete story of petroleum. The film will be loaned for educational purposes to those desiring the same after Sept. 1, by applying to the Bureau of Mines, Washington, D. C.

This is one of a number of films that have been recently completed by the Bureau of Mines showing various phases of the mining and metallurgical industry. Those requesting the loan of "The Story of Petroleum," or any other films belonging to the Bureau of Mines, are expected to pay the cost of postage both from the Washington office and return.

Device To Show Thermal Conditions in Coal Pile

A device for measuring the temperature of a coal pile at various depths, to be known as the Thornley Coalometer, has been perfected by the Federated Engineers Development Corporation. The instrument was invented by A. W. Browne, professor of chemistry at Cornell University, and R. P. Nichols, of New York.

It consists of a set of temperature indicators incased in a long pointed steel tube, carrying at varying depths metal bulbs. These bulbs and pipes connecting them to pressure gages are filled with alcohol. At the upper end of the instrument is a set of dials with pointers which indicate under all atmospheric conditions the temperature of the bulbs which actuate them. The expansion of the alcohol in the bulbs and pipes under increasing temperature controls the pointers of the gages. The scale on each dial starting at 32 deg. F. runs upward. It is colored black until it reaches 120 deg., when it changes to red, indicating when the hand reaches this point that there is excessive heat in this zone, giving warning that this portion of the pile should be removed. The units are made in two lengths, 12 and 17 ft. These carry, respectively two and three temperature



THE THORNBY COALOMETER

indicators, the bulbs being placed at five-foot intervals below the surface mark on the stem of the instrument.

Several of these devices are forced down into the coal pile at varying depths and at various localities. Collectively, they furnish accurate information of temperatures existing throughout the coal pile. To be effective, a complete installation of these units should be used, the number depending on the size of the coal pile.

Tests have shown that indicators placed at fifty-foot intervals in either direction will give efficient service and indicate temperature conditions throughout the entire pile.

Electric Welding Machines—Alternating Current Equipment

By L. W. WEBB
Master Electrician, United States Navy Yard, Norfolk, Virginia

Welding from alternating-current circuits with either a resistance or a reactance is first discussed, and then three special types of welding transformers are considered.

ALTERNATING-CURRENT welding is done principally with metallic electrodes. Very little carbon-pencil or carbon-electrode welding has been done with alternating currents up to the present time. The power factor of alternating-current welding apparatus as at present furnished is low. This has been its greatest drawback and has prevented to a large extent its general use in places where otherwise it was excellently adapted, since in most cases welding can be done about as well with alternating as with direct current. In general, alternating-current welding is done as follows:

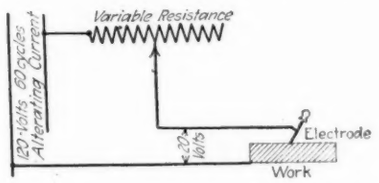


FIG. 1. WELDING CIRCUIT WITH SERIES RESISTANCE

1. With a voltage of 120 or higher a resistance is used in the circuit to reduce this pressure to approximately 20 volts at the arc (see Fig. 1). Welding under this condition is done by using coated or special electrodes of the various types. This method is very inefficient from the standpoint of power input to power delivered to the arc, and it is always necessary to ground one side of the circuit unless the work is insulated from the ground. Grounding is very undesirable, since there is always danger of the operator being burned or damage resulting to some electrical apparatus connected to some other part of the circuit. However, when welding has to be done in locations where circuits are not provided to care for the operation of motor-generator type machines, the foregoing method can generally be used to advantage and good welding can be done under these conditions.

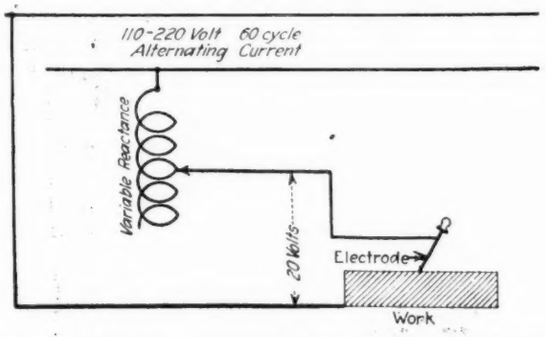


FIG. 2. WELDING CIRCUIT WITH SERIES REACTANCE

2. By the use of a simple reactance, Fig. 2, either from 110- or from 220-volt alternating-current circuit, usually sixty cycles (on circuits where the frequency is 25 cycles or lower, welding is very difficult). Welding by this method can be done and is especially desirable where the circuits contain sufficient copper to care for the low power factor under welding conditions, when the work is located at such points as cannot ordinarily be reached by a motor-generator type machine. It has, however, the same disadvantage mentioned in the foregoing; that is, unless the work is insulated it is necessary to ground one side of the circuit. On 110-volt circuits it is more difficult to do welding than when a 220-volt circuit is available, and it is very desirable to use covered electrodes when possible in welding from a 110-volt circuit, but with the 220-volt circuit any type of electrode can be used to good advantage.

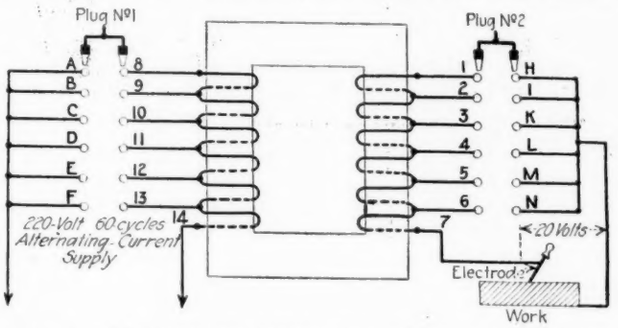


FIG. 3. WELDING TRANSFORMER WITH PRIMARY AND SECONDARY WINDING ON SEPARATE LEGS OF MAGNETIC CIRCUIT

3. Where specially designed transformers with independent primary and secondary windings are used, the transformer is usually of the high-leakage type to provide regulation from no-load voltage of approximately 75 to 110 to the arc voltage of 20 volts under welding conditions.

Fig. 3 shows a diagram of a General Electric Co.'s welding transformer. As can be seen, this is a single-phase transformer with primary and secondary windings, wound on separate legs of a closed-core magnetic circuit. Each winding is electrically insulated from the other and has its own separate combination of taps, so that all or part of the total turns can be used as desired to get various welding combinations of current and arc-striking voltage. The table given herewith shows the combinations for a 20-kva. 220-volt 60-cycle transformer while total voltage ratio of primary to secondary is two to one.

VOLTAGE COMBINATIONS FOR WELDING TRANSFORMER FIG. 3
Rated Volts Applied on Primary

Plug No. 1 in		Plug No. 2 in H	I	K	L	M	N
A	Amperes welding circuit	80	90	100	110	120	130
	Striking voltage	110	100	92	85	80	75
B	Amperes welding circuit	90	100	110	120	130	140
	Striking voltage	120	110	101	93	88	83
C	Amperes welding circuit	100	110	120	130	140	150
	Striking voltage	131	119	110	102	96	90
D	Amperes welding circuit	110	120	130	140	150	160
	Striking voltage	141	129	118	110	103	97
E	Amperes welding circuit	120	130	140	150	160	170
	Striking voltage	150	136	125	116	110	103
F	Amperes welding circuit	130	140	150	160	170	180
	Striking voltage	160	145	133	124	117	110

With this type of transformer welding can be very easily done from 60-cycle alternating-current circuits and the power factor will be approximately 25 per cent. Owing to the multiplicity of taps it is very easy to obtain the various welding currents desired with different open-circuit striking voltages, so that even inexperienced operators can do satisfactory welding with this apparatus. It is compact and easily portable, and in locations where only single-phase circuits are available, it can be used to good advantage. The unit is of the air-cooled type by natural ventilation, and no fan to provide forced cooling is necessary. Welding currents from 80 to 180 amperes can be obtained. As the coils are on independent legs, the regulation is obtained by magnetic leakage while the current is flowing, which changes the voltage ratio fixed by the coil-turn ratio on open circuit.

A wiring diagram for an Electric Arc Welding Company's welding transformer is shown in Fig. 4. This transformer has two legs of a closed core each containing windings and one leg a movable core. The primary and secondary coils are so wound on the first leg as to have very little flux leakage between them. On the other leg is another secondary winding in series with that on the first leg and also in series with coils having three turns each on the horizontal part of the core between the two legs. The open-circuit voltage on this transformer is made variable by a combination of taps on both secondary coils.

Regulation from open-circuit voltage to welding-arc voltage is obtained by flux leakage through an adjustable core and also by the coils wound on the horizontal

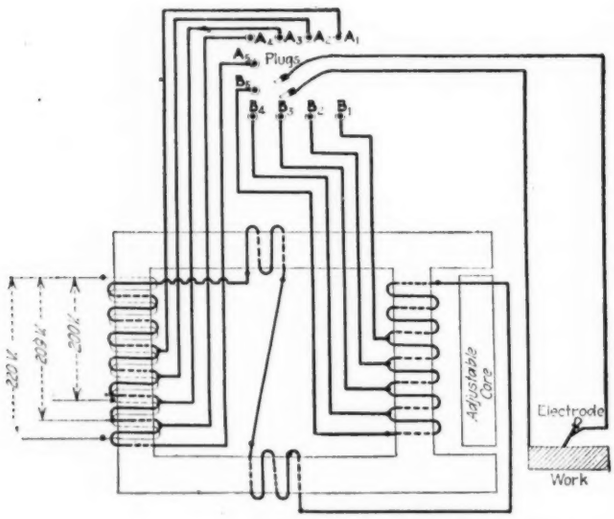


FIG. 4. TRANSFORMER WITH ADJUSTABLE CORE

path assisting in causing leakage. The primary coils are provided with taps to take care of a 5 to 10 per cent drop in the supply voltage. Welding-current combinations variable from 75 to 150 amperes can be obtained by the use of the various taps on the windings.

Experienced operators can do good welding with this type of transformer either with bare, coated or covered electrodes, but it is very difficult for anyone except an experienced operator to obtain satisfactory results when bare electrodes are used, especially on overhead work. However, with covered electrodes ordinary operators can obtain good results.

There is an auxiliary secondary coil, not shown, having 28 turns on the secondary leg, which serves the purpose of keeping down the open-circuit voltage across the electrode and work when welding is not being done, to about 30 or 40 volts, and thus prevent possible chance of the operator receiving a shock while changing the electrodes or before welding is commenced. When the

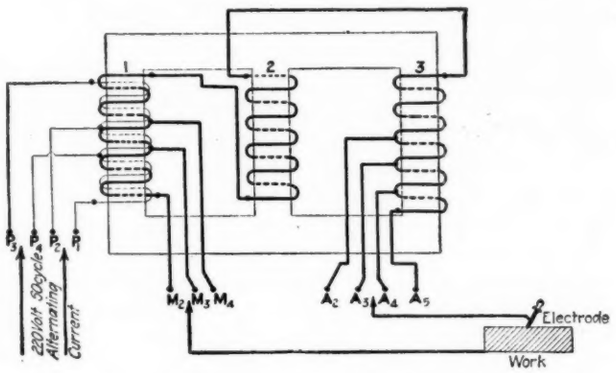


FIG. 5. TRANSFORMER WITH THREE-LEGGED CORE

welding operation is started, the current flowing through the auxiliary secondary winding causes the contactor to close the main welding circuit and at the same instant opens this winding; then the full striking voltage of the main secondary winding is available for welding. As soon as the arc is broken, the contactor opens the current circuit and again makes contact on the small closing coil on the auxiliary secondary windings so that the same operation will be repeated when the electrode is again touched to the work.

The transformer built by the Arcwell Corporation, Fig. 5, is a single-phase unit of the three-leg type. Leg No. 1 has the main primary winding and the main secondary winding. Leg. No. 2 has an auxiliary secondary winding connected in series with the main secondary winding and another secondary winding on leg No. 3. The primary winding has taps provided to take care of supply-voltage variations of 5 per cent above and below normal. The secondary coils on leg No. 1 and leg No. 3 have taps so that various welding-current combinations between 70 and 200 amperes can be obtained. Regulation of this transformer is obtained by the winding on leg No. 2 being so wound as to cause high leakage when a current is flowing, which decreases the open-circuit voltage from approximately 75 or 110 volts to 25 volts at the welding arc, depending on the current setting of the particular open-circuit voltage.

With this type of transformer welding can be easily done with 60-cycle alternating current and give a power factor as high as 30 per cent.

Constant-current type of transformers may be used with one or more operators in series, and automatic cutouts provided at each operator, Fig. 6. This type of transformer is usually similar to that supplied for series arc lighting, with movable secondary coils and provided with automatic or hand regulation for the various welding currents and number of operators connected. With this type of control it is essential that each operator's work be insulated from the ground and also from each other. Furthermore, the regulation, when one of the operators starts and stops work, etc., must necessarily be very rapid so as not to disturb the must be rapid so as not to disturb the other circuits.

This type of welding transformer should show high over-all efficiency when conditions are such that a number of operators can be worked from the same transformer, and should have a power factor and efficiency much higher than the single-operator transformers now on the market. Its use as a portable welding appliance, however, will never be successful, especially where work has to be done on metal ships, etc., and therefore its application will always be restricted to shops where

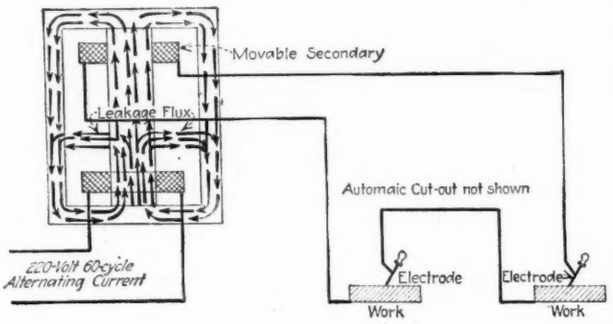


FIG. 6. DIAGRAM OF CONSTANT-CURRENT TRANSFORMER

work can be properly insulated and where the current required by each operator is the same.

All the transformers described in this article are of the high-leakage type with power factors under normal-load conditions ranging from 20 to 35 per cent. This means that when a number of operators are working from the same circuit, it is necessary to supply more copper from the distributing mains than would be required from an ordinary circuit supplying power to the same number of operators working from motor-generators. But as these transformers are easily portable, do not require any special attention, and as their first cost is low compared with that of motor-generators, they can be used to great advantage in many locations. This is especially true in places where single-phase circuits only are available, from which it would be undesirable to operate any form of motor-generator of capacities that are as high as that required for welding machines.

While satisfactory welding can be done with these transformers, usually they are not capable of producing as much output as the motor-generator type of machine. But it is believed that when designs become more efficient no reason exists why equally good results cannot be obtained with them as with direct-current circuits from special motor-generators. However, until some form of power-factor correction is designed for use with these transformers so that the power factor of the current taken by them is much higher than that obtained at the present time, their use will be somewhat restricted.

Of course, in many cases where the work is located in places that are inaccessible to power supply, generators driven by gasoline engines of the portable type can be supplied, which can be readily transported from place to place. But the first cost of these gasoline-engine driven generating sets is high and likewise the maintenance cost, and they ordinarily require more attention than any other form of welding machine. The use of these transformers, therefore, will in many cases be the best solution and their application under these circumstances economical.

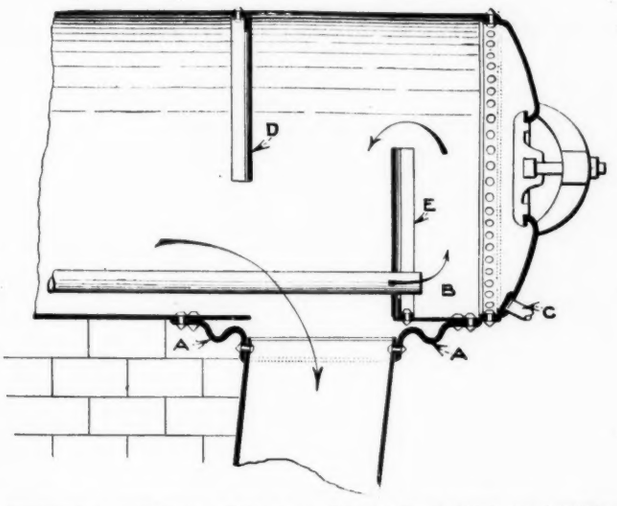
Corrugated Boiler Flange and Feed-Water Purifier

A steam boiler should be so constructed that internal strains due to unequal expansion are avoided. If a feed-water purifier can be embodied in the boiler construction, a desirable feature has been added. This is what the Union Iron Works, Erie, Pa., has done in the design of their water-tube boiler.

Expansion strains between the header and the drum are taken care of by the adoption of a corrugated flanged connection *A* from the drum to the header, which also provides an opening of large area for unrestricted water circulation; it requires no throat bracing. The illustration shows a sectional view of the rear portion of tne drum and the corrugated connection between the drum and the heads. The flange connections are riveted.

A feed-water purifier that is out of the fire zone and path of circulation is made possible by carrying the drum well beyond the rear header and forming a separate purifying settling chamber, as at *B*, where practically all of the precipitates and solids are removed from the water before it passes into the drum proper. The purifying chamber is equipped with a blowoff *C*. The illustration shows the position and construction of this settling chamber.

Feed water is brought in at the front end of the drum and is carried through to the rear in an internal feed pipe that discharges at the boiling point into the purifying chamber, where the solids and other impurities readily precipitate and are blown out through the blowoff pipe at intervals.

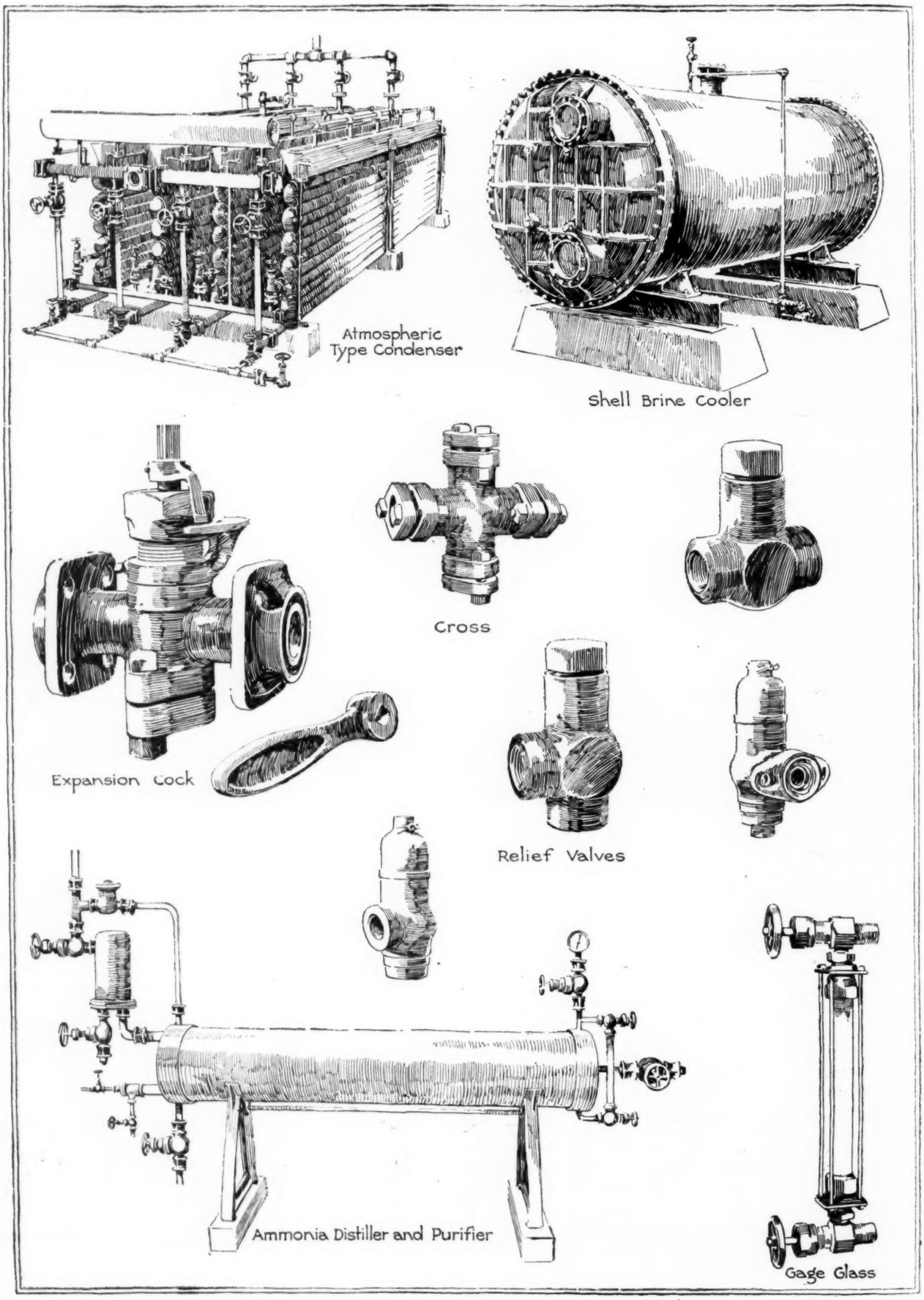


SHOWING CORRUGATED FLANGE AND WATER PURIFIER

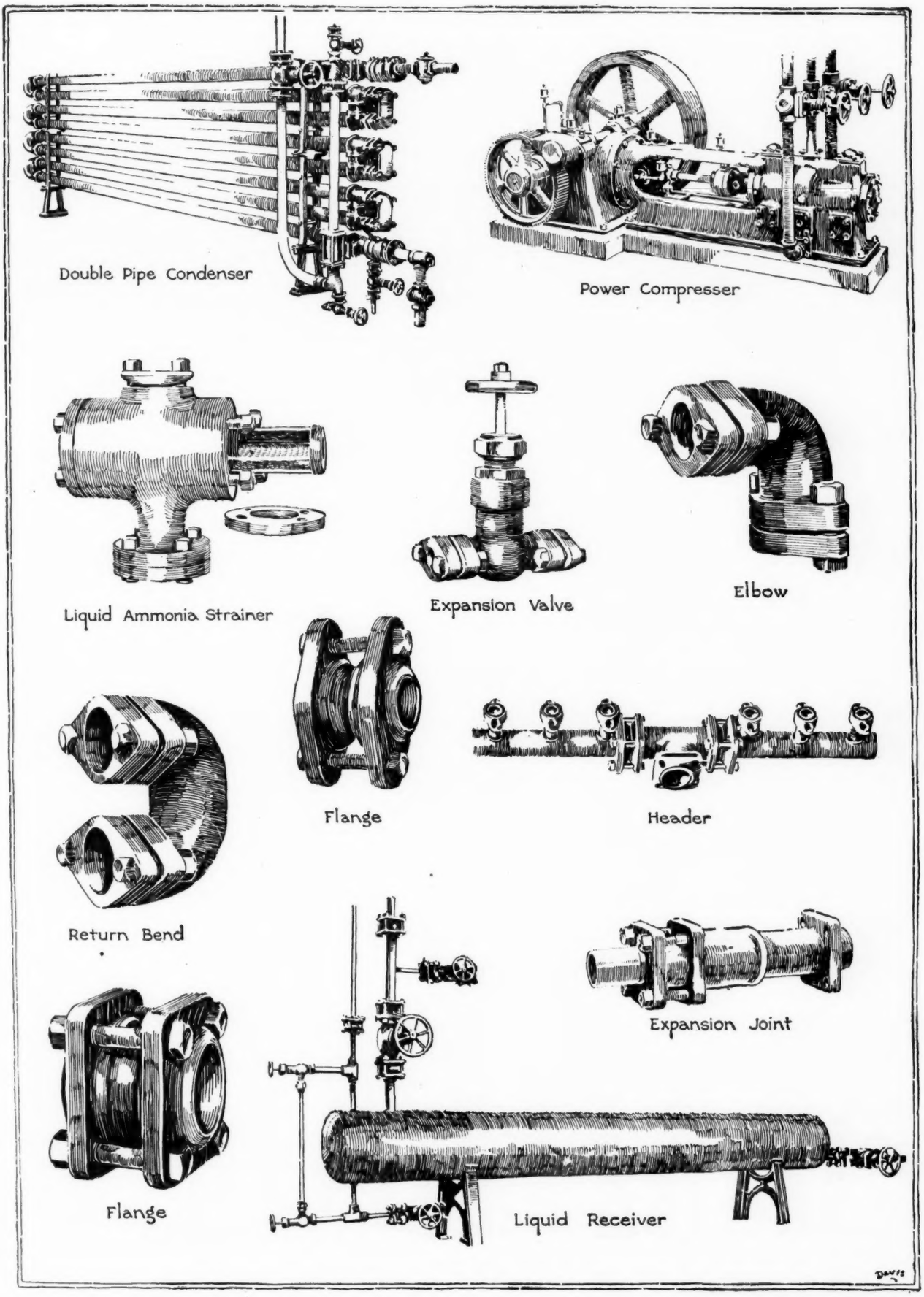
Baffles *D* and *E* isolate the purifier and conducting water from the rest of the drum without obstructing the circulation from the front to the rear of the drum.

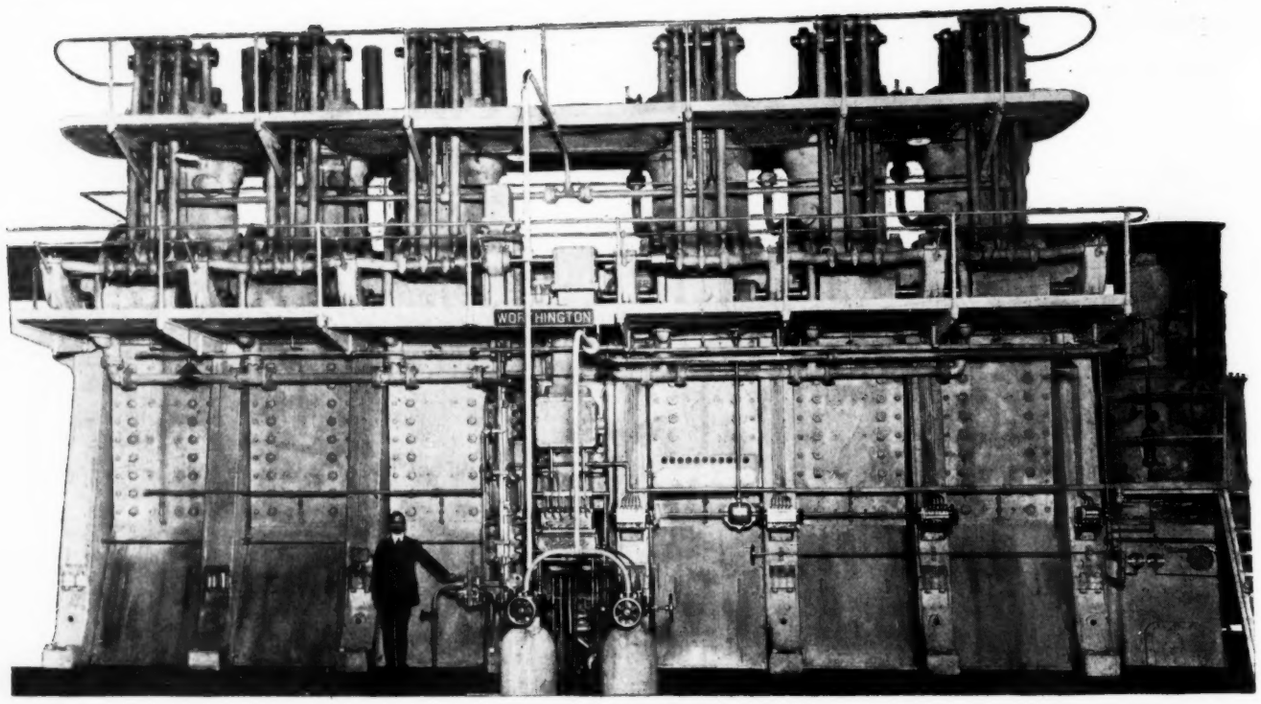
According to the report of a French investigating committee the United States is rated as having 30,000,000 hp. in water power, Canada 25,000,000, Norway 7,500,000, Sweden 6,750,000, Austro-Hungary district 6,450,000, Italy and Spain about 5,500,000 each. Germany's water power is estimated at only 1,500,000 hp., and that of England is about 1,000,000 hp., but these two countries are richly compensated in coal.

Views of Some Fittings and Apparatus That Are



Commonly Used In Refrigerating Plant Practice





Worthington 2,400-Horsepower Marine Diesel

THE Worthington Pump and Machinery Corporation has on the test floor at the Snow-Holly works a 2,400-hp. marine Diesel, which has been built from their own designs and which, incidentally, is the largest four-cycle marine Diesel yet built. The engine is of the vertical single acting crosshead type and has six cylinders mounted on cast-iron A-frames, which in turn are mounted on a bedplate, or base.

The bedplate is cast in two parts, which are held together by bolts passing through reamed holes. The transverse members of the base carry the housings for the crankshaft bearing; the housings are bored, so that the semicircular lower bearing valves can be removed by rolling them from under the shaft. The bottom of the base is cast solid, forming an oil pan. The frames, which appear in Fig. 1, are eight in number, and have a box section. The legs on the far side are solid, while each of the front legs has a gap at the base to allow the crankshaft to be removed for the yearly inspection. The gap is filled by a tapered block which is bolted and doweled into its place, thereby making the front legs as rigid as the rear ones. This feature, from the operating standpoint, is excellent. The frame, while it supports the cylinders and gives the necessary rigidity, is not called upon to bear any of the working stresses. These stresses are taken up by a series of tension rods that pass through the frames, tieing the cylinder bases to the bedplate.

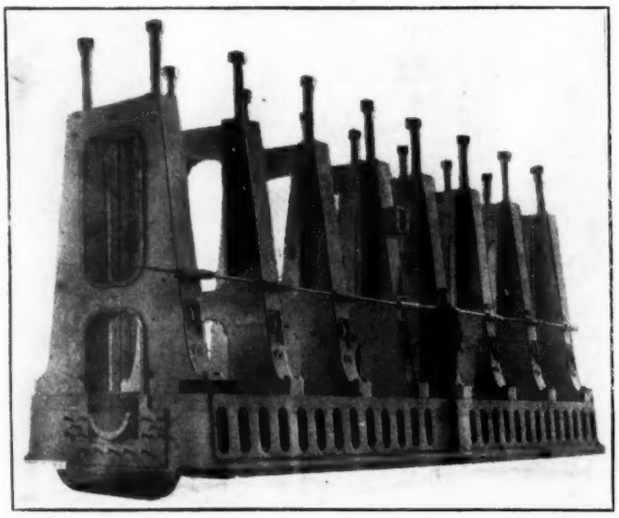


FIG. 1. ENGINE A-FRAMES

An unusual feature is the employment of bases for the cylinders. A casting is placed on the A-frames and in turn supports the cylinders. Each casting, or cylinder base, supports three cylinders and rests on four frames; stuffing boxes accommodate the pistons and prevent the ingress of water or fuel oil into the frame.

The cylinder, as will appear from Fig. 2, is made up of a cast-iron liner pressed into a cast-iron jacket, the jacket taking the axial stresses. The cylinder heads are of symmetrical design, openings being provided for the exhaust, admission, fuel and starting valves. The fuel-valve cavity is not located in the center, but is offset slightly. This gives more space for the cooling water. A copper thimble, or bushing, serves as the wall of the fuel-valve cavity.

Since a crosshead is incorporated into the design of the engine, the piston is short and rigidly connected to the piston rod, which is flanged at its upper end. The water for the cooling of the piston enters and leaves through telescopic tubes. The tubes are provided with caps and are of a length that effectually prevents leakage.

The crosshead guides are bolted to the rear legs of the frame. The slippers bear against the guides and are bolted to the square steel crosshead.

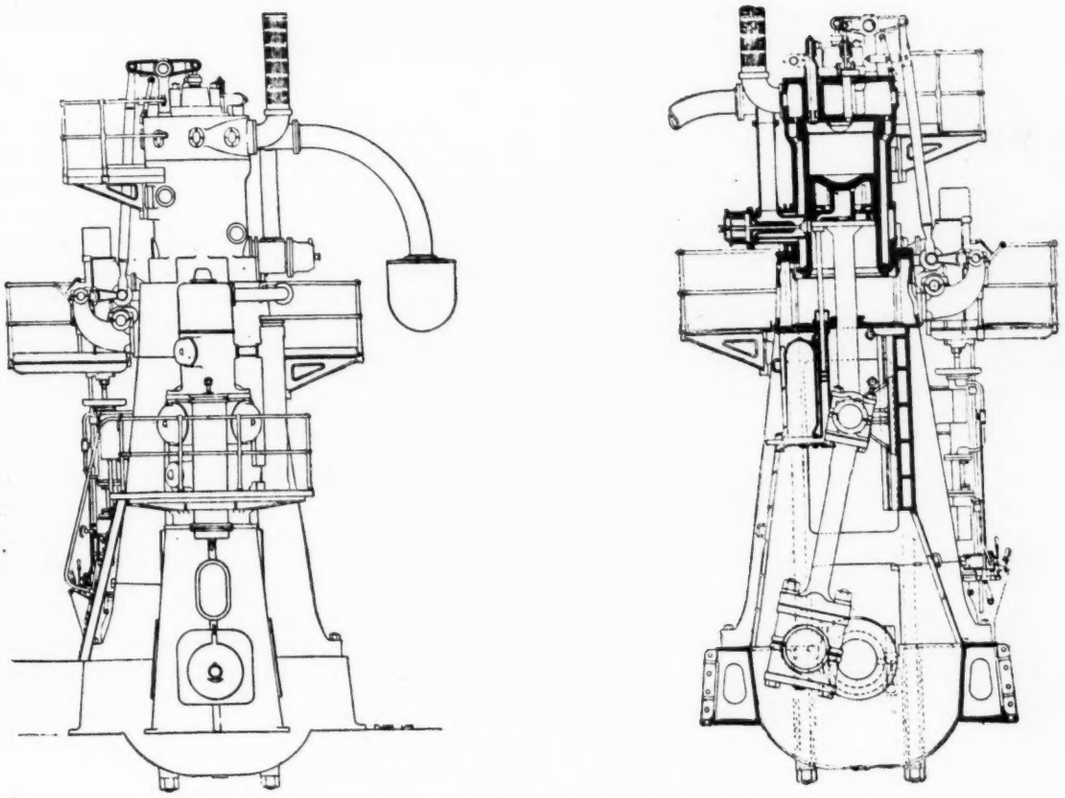


FIG. 2. SECTION AND END VIEWS

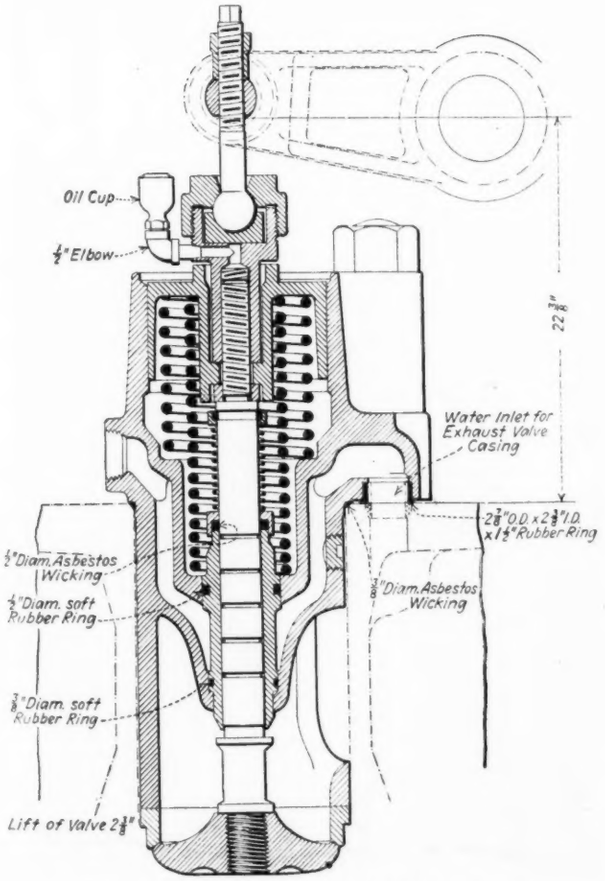

Oil Cup
½" Elbow
22⅞"
Water Inlet for Exhaust Valve Casing
2⅞" O.D. x 2⅜" I.D. x 1⅛" Rubber Ring
½" Diam. Asbestos Wicking
½" Diam. soft Rubber Ring
⅞" Diam. soft Rubber Ring
⅝" Diam. Asbestos Wicking
Lift of Valve 2⅛"

FIG. 3. ADMISSION AND EXHAUST VALVES

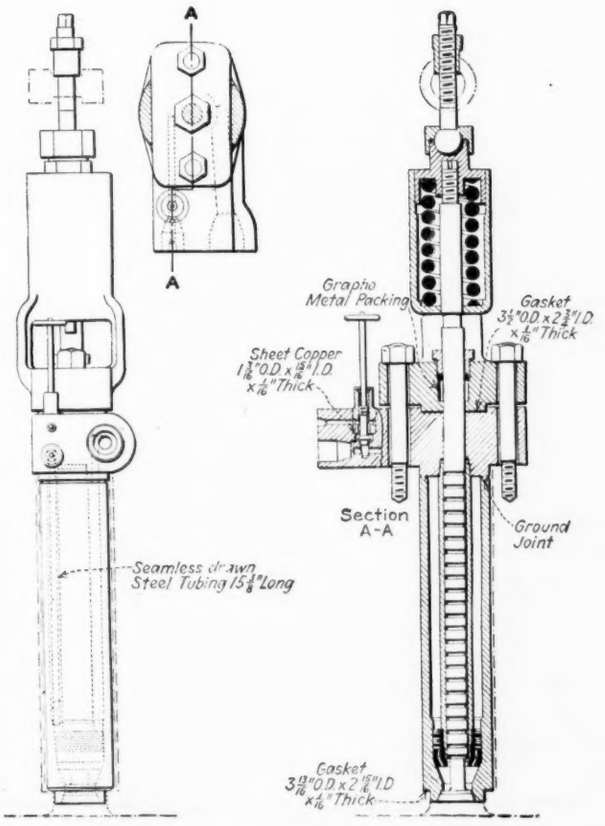

A
A
Graphio Metal Packing
Gasket 3½" O.D. x 2¾" I.D. x 1/16" Thick
Sheet Copper 1⅛" O.D. x 1⅛" I.D. x 1/16" Thick
Section A-A
Ground Joint
Seamless drawn Steel Tubing 15⅝" Long
Gasket 3 13/16" O.D. x 2 15/16" I.D. x 1/16" Thick

FIG. 4. FUEL, OR SPRAY, VALVE

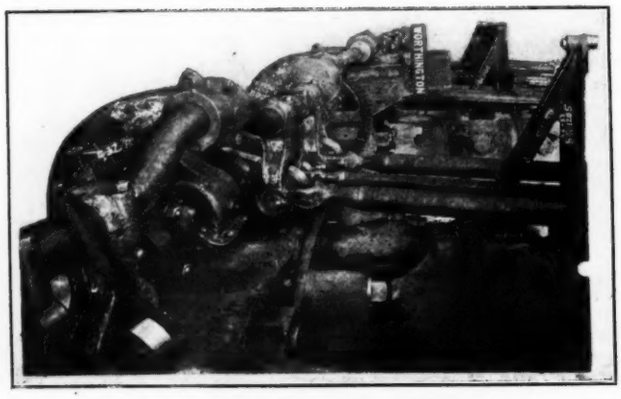


FIG. 5. VIEW OF THE CAMSHAFT

The cranksaft is in two sections, bolted together by means of flanges. The crankpin bearings are of a standard marine type, compression being altered by shims between the bearing and rod.

The admission and exhaust valves, with their cages, Fig. 3, are interchangeable and provision is made for watercooling, although only the exhaust-valve cage is connected up to the water system. The use of two springs with each valve is another attractive feature; stoppage of the engine because of a defective spring should be eliminated by this design. Stuffing boxes on the valve spindles seem unnecessary, but leakage is undoubtedly prevented. False seats for the valve cages are features that are worthy of remark. The valve stem is of steel and is screwed into the cast-iron valve and riveted over.

The fuel, or spray, valve, Fig. 4, is somewhat unusual in American design, having the valve opening inward; this is quite like the Burmeister & Wain plate and, it is claimed, gives a better shape to the valve. The design eliminates the customary flame oil spray as it enters the cylinder. The wiredrawing across the seat should effectually prevent any particles from being deposited on the valve seat. The valve cage has a copper gasket at the lower end. The upper end of the body has a ground joint with a flange which carries the air and oil connections. Above this flange is bolted a block carrying the valve-spring dashpot. The oil passes into the cage through a copper tube, covering the top and openings of the atomizer discs. The top flange is equipped with a bypass valve to clear the oil line of any air that might be present.

In addition to the main exhaust valve an auxiliary exhaust valve is placed in the cylinder barrel well toward the bottom end. The piston, as it nears the end of the power stroke, uncovers this valve. Since the spring holding the valve seated has but little strength, the pressure opens the valve, allowing the major part of the charge of hot gases to pass out through this valve. The main exhaust handles only a small part of the gases. On the compression stroke, the air has a very low pressure during the interval before the piston covers the auxiliary valve, consequently the valve remains closed. This feature should do much toward lessening the number of stoppages at sea to regrind valves.

The various valves are opened by rockers actuated by push rods. The rods are seamless steel tubing with welded forged steel ends. The lower ends, which bear rollers, are linked to the reversing shaft, as is shown in Fig. 5.

The fuel pump consists of a steel box with a plunger for each engine cylinder. Control is secured by limiting the lift of the suction valves, quite similar to the arrangement on a number of other Diesel engines. The plungers and the suction-valve tappet shafts are driven by two eccentrics mounted on the top wheel of the camshaft gear train drive. Fig. 6. shows the pump and control levers.

The reverse and control are obtained in a very simple and positive manner. An air cylinder *B*, Fig. 6, is provided with a piston and rod. The rod at its upper end is fitted with a rack and a cam plate. This latter bears against rollers fastened to the camshaft. The rack engages a pinion keyed to the reverse shaft. When the handle of the reversing valve *A* is thrown to "astern," the air enters the lower part of the air cylinder *B*. This forces the piston rod upward. The rack revolves the reverse pinion, which rotates the reverse shaft. The links connected to the valve push rod then pull the rollers out of contact with the cams. The cam plate on the reverse piston rod has moved upward during this period, and as the rollers clear the cams the curve on the cam plate engages the roller block and

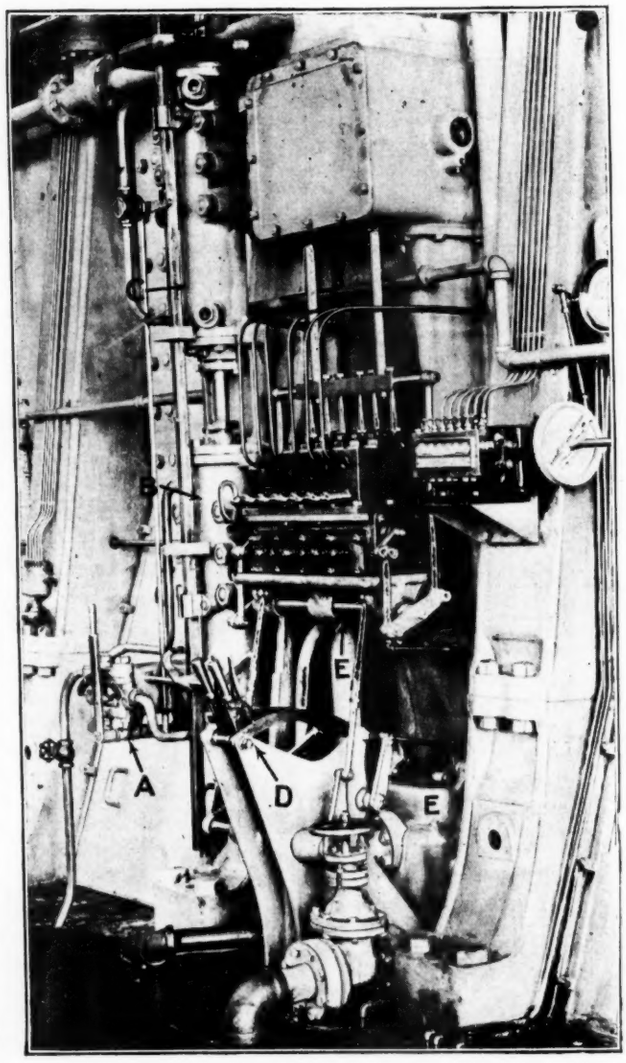


FIG. 6. FUEL PUMPS AND CONTROL

shifts the entire camshaft to the right, bringing the astern cams under the rollers. Further movement of the rack brings the push rod back onto the astern cams. An oil cylinder *C*, Fig. 6, equipped with a bypass valve actuated by the reverse lever, effectually locks the reverse in position. The engine is now ready to run astern.

Two control levers *D* are provided, thereby allowing three cylinders to be cut out when running at low speed. After the reversal has been accomplished, the control lever is moved inward. When the lever reaches its first position, the air valve *E* is opened. As the engine comes up to speed under the influence of the air which is admitted into all the cylinders, the control lever is shifted farther inward; this cuts out the air and admits the fuel. The fuel pump is controlled by the shaft *E*, which alters the opening of the pump-suction valves.

The air compressor is located at the forward end of the engine frame, being driven by a crank on the main crankshaft. This serves to lengthen the engine; undoubtedly on larger units the compressor should be driven by an independent engine. The compression valves are the well-known Laidlaw feather valves. Intercoolers and aftercoolers are provided.

Forced-feed lubrication is used on all the principal parts. A motor-driven pump draws the oil from a sump below the engine-room floor and discharges it at 15 lb. pressure into a fore-and-aft header on the outboard side of the engine. Branch pipes lead to all the main bearings; the crankpin is fed through diagonal holes from the main bearing. From the crankpin the oil flows up through the connecting rod, lubricating the wristpin and crosshead guides. The used oil drips down into the engine, from where it is collected and passed through an oil filter.

Salt water is employed for cooling purposes. The entire crankcase is sealed against the entrance of the water, eliminating all danger of injuring the lubricating properties of the oil. The general dimensions of the engine are as follows: I.hp., 2,400; b.hp., 1,750; m.e.p., 85.5; mechanical efficiency, 75 per cent.; bore, 29 in.; stroke, 46 in.; compression, 500 lb.; injection, 900 lb.; main bearings, 17½ x 24 in.; crankpins, 18 x 15 in.; wristpins, 10½ x 9½ in.; length, 55½ ft.; height, 23¾ ft.; weight crankshaft, 36½ tons; weight engine, 339¼ tons; weight per i.hp., 327 lb.

Checking Four-Wire Three-Phase Switchboard Wattmeters

By H. C. Yeaton

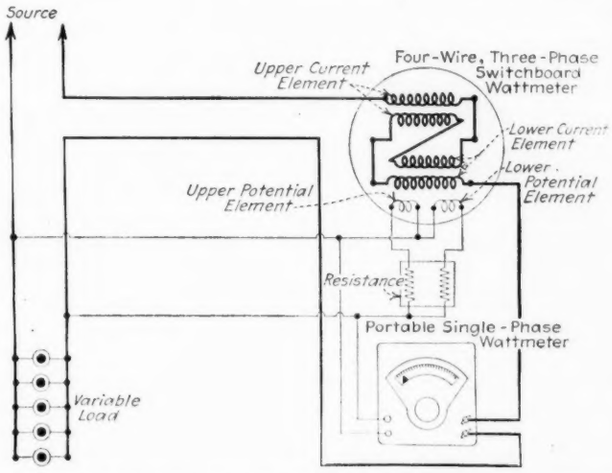
The accuracy of all switchboard instruments should be frequently checked to ascertain that they are functioning correctly. The following explains the general method of checking a four-wire three-phase switchboard wattmeter:

Short-circuit the current transformers, if the instrument is used with current transformers, and then disconnect the wattmeter from the circuit. The switchboard wattmeter should then be connected, together with a single-phase portable wattmeter, on a single-phase circuit, as shown in the figure. A variable load is shown in the diagram, which is for obtaining different readings. All current coils of the switchboard wattmeter are connected in series, and the potential coils, together with the instrument resistances, are connected across the circuit.

The current winding of the single-phase portable wattmeter is connected in series with the current windings of the switchboard wattmeter, and the potential winding of the portable meter is connected across the circuit. It is therefore obvious that the current that passes through the current coils of the switchboard wattmeter also passes through the current coil of the single-phase portable wattmeter. The potential across the potential elements of the switchboard instrument is the same as that across the potential element of the portable meter.

The calibrating watts per element of a four-wire three-phase wattmeter are equal to *Scale Reading* ÷ *Current-Trans. Ratio* × *Potential Trans. Ratio* × 4. Therefore, by determining the calibrating watts of the switchboard four-wire three-phase wattmeter from the foregoing formula, its scale readings may be checked with the single-phase portable meter.

Suppose that the four-wire three-phase wattmeter is used on a circuit of 2,200 volts and 100 amperes. Each



WIRING DIAGRAM FOR TESTING 4-WIRE 3-PHASE WATTMETER ON SINGLE-PHASE CIRCUIT

potential transformer has a ratio of 20:1 (that is, 2,200 to 110 volts), and each current transformer has a ratio of 20:1 (or 100 to 5 amperes). The watts of the circuit would be 2,200 × 100 × 3, or 660 kw.; but as a 660-kw. scale would have rather an uneven ending, a 700-kw. scale would probably be selected.

Connect the instruments on a 5-ampere 110-volt circuit as in the figure. If the pointer on the switchboard wattmeter indicated 600 kw., then the calibrating watts for this point would be equal to $\frac{600{,}000}{20 \times 20 \times 4}$ = 375 watts, and the switchboard meter would be correct if the portable meter read 375 watts. By substituting the readings 100,000, 200,000, 300,000, 400,000, 500,000, 600,000 and 700,000 in the numerator and dividing by the denominator 20 × 20 × 4, the following calibrating table is obtained:

Switchboard-Wattmeter Readings in Kilowatts	Calibrating Watts per Element of Switchboard Wattmeter	Portable Wattmeter Readings in Watts
100	62.5	62.5
200	125.0	125.0
300	187.5	187.5
400	250.0	250.0
500	312.5	312.5
600	375.0	375.0
700	437.5	437.0

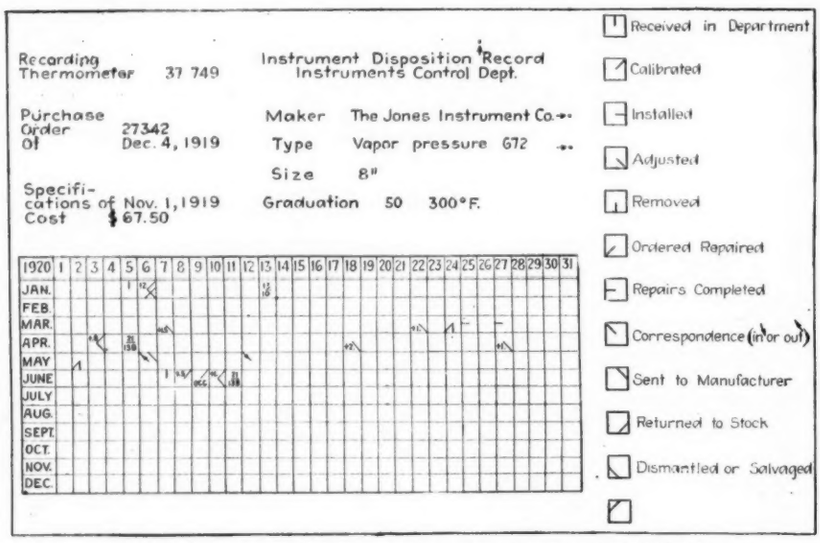
Other readings may be checked in the same way, if required.

An Instrument Record System

BY FREDERICK J. SCHLINK

The card-record system herein illustrated is in the main a combination of the author's type of progress-of-work charting scheme[1], combined with some of his methods of card-index operation[2]. The system to be described has provided the rather complex and minutely detailed information required of it so satisfactorily that it is thought that others having control of instruments or similar plant units in considerable numbers might find it useful.

The illustration gives the code of symbols used in the card form of record, each of these symbols being drawn within a square corresponding to the date on a printed and ruled 4 x 6-in. card form. The reverse of the card is cross-ruled to care for a second year's entries. By using a 5 x 8-in. or even 8½ x 11-in. card, four or more years could readily be recorded without using a second card for the same instrument. The specimen card, considered with the code, will be self-explanatory; the table, however, gives a complete enumeration of the significance of the symbolic entries in the date area.



INSTRUMENT RECORD SYSTEM AND KEY OF SYMBOLS

READING OF SYMBOLS AS INDICATED ON CHART

Jan.	5	Received in Instruments Control Dept.
Jan.	6	Calibrated; error = +2.0°
		Adjusted
		Returned to stock.
Jan.	13	Installed on heater 10, Dept. 13.
Mar.	7	Adjusted down (to agreement with mercurial thermometer) on account of a discrepancy of + 1.0 deg.
	22	Adjusted down (to agreement with mercurial thermometer) on account of a discrepency of +1.0 deg.
	24	Removed
		Ordered repaired
	25	Completion of repairs promised
	27	Repairs actually completed
Apr.	3	Calibrated; error + 0.8 deg.
		Adjusted
	5	Installed on heater 13B, Dept. 21
	18	Adjusted down (to agreement with mercurial thermometer) on account of a discrepancy of +2.0 deg.
	27	Adjusted down (to agreement with mercurial thermometer) on account of a discrepancy of + 1.0 deg.
May	2	Removed from heater
		Ordered repaired
	6	Sent to manufacturer, with outgoing letter.
	12	Incoming letter
June	7	Instrument (again) received in Instruments Control Dept.
	8	Calibrated; error +0.5 deg.
	9	Special permanency test on the thermometric oscillator
	10	Calibrated again error (increased to) +1.0 (as result of oscillatory test)
		Adjusted
	11	Installed on heater 13B, Dept. 21

Arrows will be noted at points on the upper and right-hand margins of the card; the former has been applied to mark a black ink dot on the top edge of the card, which by its position alone (measured from the upper left-hand corner of the card) shows exactly on what plant unit and in what department the instrument was last installed. Each 0.02 in. from the left-hand edge of the card corresponds to a different numbered heater or press; a maximum of $\frac{6}{0.02}$ or 300 different plant units can be indicated in this way on the 4 x 6-in. card. On a larger card it would be advantageous to open up the scale somewhat, if possible, in order to facilitate finding of the dot; 0.03 in. or 0.04 in. would be a more desirable spacing. Finding the edge dots by means of a simple sheet-metal gage or master card which is run along the top edge of the record cards while they remain aligned in the file drawer, permits of the instrument card being located even when the identification number of the instrument is not known, but only the number of the production unit on which the instrument is used. The primary arrangement of the cards is in order of the serial or identification numbers of the instruments themselves. The two dots on the right-hand elge show that the instrument has been subjected to the regular monthly inspection during April and June, the month positions being measured from the upper right-hand corner of the card. When all inspections of a given month have been completed there will be a continuous line of such dots from front to back of the file of these cards in the appropriate position, which enables any instruments that have been missed by accident or other cause, to be at once detected without the necessity of handling the cards individually. For further information on this method of recording, the reference of footnote 2 should be consulted.

The writer sees no reason why this method, which has proved completely adapted to work on measuring instruments, should not be well adapted also to other plant equipment of which a performance history is kept, such as electric motors, elevators, etc. The general principles shown are capable of wide extension and modification in details for particular purposes.

[1] "An Improved Progress-of-Work Chart," *Journal* of the Franklin Institute, May, 1918, p. 186.

[2] "Getting the Most Out of Index Cards," *Industrial Engineering*, Feb., 1918, p. 135.

Suggestions for the Semi-Diesel Engineer

The hot-bulb or combustion chamber should be cleaned very frequently. If a heavy oil is burned, a monthly cleaning is about correct.

Don't fail to close the water-injection valve when stopping the engine. If this is neglected, the cylinder may be flooded.

If the ignition device is hot, open the water-injection valve as soon as the engine begins firing. This will eliminate the danger of the cylinder-head joint leaking.

EDITORIALS

Both Suffering from Past Ill Repute

SYNCHRONOUS motors in many industries have come to be recognized as an efficient means of driving various classes of equipment and have even been developed to the point where they may be started and stopped automatically, in a manner similar to the direct-current motor or induction motor. Yet the record of this machine during its early applications still remains and undoubtedly has acted as a deterrent to its more general use today.

When synchronous motors were first used, they were nothing more than alternating-current generators applied to motor service. These machines, when operated as generators, had characteristics that were far from satisfactory and, when applied as motors, gave all kinds of trouble. First, they had to be started by some auxiliary source and brought up to speed and synchronized before being connected with the source of power, after which the load was applied through a mechanical clutch or other means. After these early types of motors were on the line, they had a tendency to hunt and to try to adjust themselves to every disturbance on the circuit; as a result the operation was in general unsatisfactory. However, when these machines were designed as motors with squirrel-cage windings in the pole faces, they developed characteristics that compare favorably with other types of alternating-current motors and in some respects they are superior. But this type is still suffering from the ill repute it fell into in its early application.

The mechanical clutch that was used to connect these machines to their loads, and for many other applications, developed anything but an enviable reputation, its reliability being low and its maintenance high. Therefore as pointed out in the Electrical Development Committee Report of the Association of Iron and Steel Electrical Engineers, presented at the Fourteenth Annual Convention, "the magnetic clutch, purely by reason of its name 'clutch,' has fallen heir to the ill repute of the mechanical clutch." However, experience with synchronous motors applied to various heavy drives through magnetic clutches, in rubber and cement mills, has shown this combination to give entire satisfaction. The clutches are easy of application, have low maintenance charges, are simple to adjust and are readily adapted to remote control, which makes them adaptable as safety devices where necessary. Because of the current lag the clutch requires a considerable period to reach full strength. Thus the load is automatically applied gradually to the motor.

These clutches have been successfully applied to synchronous motors up to six hundred horsepower in size. Whatever the bad record of the predecessor of the modern synchronous motors and magnetic clutches may have been, modern designs have proved their reliability by several years' service in very heavy application, and the future should see a wider application of synchronous motors to heavy-duty applications.

A Field for the Gas Producer

DISCONTINUANCE of the natural-gas service to all industrial plants will be in effect very shortly in all the Central States. This action is absolutely necessary to insure a supply of gas to meet the domestic demand. As a result of this step several hundred power plants now using natural-gas engines are confronted with a decidedly serious problem. In many cases the rate quoted for electric power makes this service out of question; in other instances electric service cannot be secured at any price. The investment required for the installation of an entirely new plant would be a somewhat undesirable burden to many.

The gas producer offers the cheapest and most economical solution. As the plants now stand, nothing is required to change to producer gas beyond the installation of the producer and, in some cases, change of cylinder compression. Using buckwheat anthracite, a brake horsepower can be obtained from less than one and a quarter pounds of fuel. This economy will compare favorably with natural-gas at twenty-five cents per thousand cubic feet.

The gas producers of the past enjoyed a somewhat unfavorable reputation. In almost all cases of producer failure, it is a matter of record that bituminous coal was used. Even though the fuel expense is slightly higher, only anthracite should be burned in these small producers. The type of operator that is available is quite superior to that of past years. The present operators of the natural-gas engine should easily develop into high-grade producer men.

The natural-gas situation opens up to the manufacturer of small and medium gas producers a field that should not be neglected. Unlike in former years, the prospect has already been educated to the advantages of gas-engine power. It only remains to convince him that a particular producer meets the requirements.

Commendable Co-operation

THE controversy that waged so briskly a few years ago between the central station and the isolated plant now appears to be a thing of the past. Not that the central station, like the proverbial whale, has completely swallowed the isolated plant, for there are a goodly number of the latter still grinding out kilowatt-hours, nor has the central station fared badly, as is attested by the number of extensions and new plants of large capacity now under construction. Therefore, one must look farther for the reason. There are apparently several contributing factors:

In the first place the demand for power in general far exceeds the capacity to serve, and it behooves the central-station salesman to seek only the more desirable loads. Secondly, the high cost of fuel and labor has been responsible for the shutting down of many of the inefficient private plants and leaving those whose load conditions and exhaust-steam demands justify their

independent existence. Thirdly, there appears to be a disposition on the part of many of the central-station companies to recognize and co-operate with the latter class of plants.

One of the largest central-station companies in the Middle West has adopted a broad policy of co-operation with its industrial customers. It advises those that have private plants installed to retain and operate them in conjunction with the central-station service at such load as will secure the most economical heat balance, merely reserving the privilege, in cases of necessity, of cutting off service to the extent of the remaining capacity of the private plant. Thus both parties are benefited, the industrial plant by securing more economical operation and the central station by securing what amounts to the same as reserve capacity.

Now, when the attention of the engineering profession is centered on the interconnection of power systems and the elimination of fuel waste wherever possible, a wide application of the aforementioned practice would aid materially to achieve the results aimed at.

Brighter Economic Skies

WITHIN four or five days after the calling of the strike on the Brooklyn Rapid Transit Company's system, the company is reported to have had about three thousand strike breakers on the job. Some time previous to this the Pennsylvania Railroad astounded everybody by announcing that twelve thousand men on the eastern end of that system were to be laid off and transferred. In Akron, Ohio, recently, men to the number of thirty to ninety thousand are reported to have been laid off; rumor has it that so fast did men leave that town that the railroad office ran out of tickets. As other examples, we have seen what happened to the silk and shoe industries.

Contractors all over the country report an appreciable increase in output of the men engaged in the building trades. Textile workers here and there are reported to have sensibly accepted slight reductions in wages. Talk with employers about the country, particularly in industrial centers, and you learn that so many men now come in answer to advertisements for help, that employers can make happier selections than have been possible in years.

Reports from Italy tell of a million Italians ready to come to this country as soon as they can get passage and are allowed to clear.

Many industries in New England are again getting started, on part capacity at least, after a long period of idleness.

The conditions are not ominous. They are encouraging. They mean that business is at last beginning to get back on a sound economic basis—certainly more sound than we have known for the last few years. The break, which doubtless is here, simply had to come. Things could not longer have gone on as they were going. From now on one may reasonably expect that there will be fewer staggering demands by labor, fewer attempts at ruthless profiteering, less arrogance by the seller and greater confidence and equanimity on the part of the buyer. A department head may soon be able to talk freely with men who need it without fear of precipitating a crisis in his plant. It begins to look as if the dollar is soon to be, not what it was before the war, but a little more of its former self than it has been for a long time.

American labor and American business must not forget that Germany, which in the years before the war demonstrated remarkable commercial development, is burdened with a staggering debt, that she will soon be felt as a competitor in world markets. She must get the business. And a nation, like an individual, stimulated in an emergency, is likely to do things that would give the less agitated pause.

Let us get back to work.

Emergency Drills

IN MOST factories and industrial establishments fire drills have become an established practice. The fact that they are held is no indication that the premises are especially susceptible to fire. They are merely a precaution to insure that in such emergencies everyone will know just what to do and, as a result of repeated rehearsal, will do it almost involuntarily.

Just so with the operation of any large power plant or power station. Accidents and disturbances within or without the station are always a probability in spite of preventive measures. It is most important at such times that the operators think clearly and decisively in order to do just the right thing and prevent multiplication of the trouble or sustained interruption to service.

Considering the intricacies of the modern power station and electrical system it is a tribute to engineering skill and design that troubles are not more frequent. Notwithstanding protective and automatic devices nothing will take the place of an alert and properly trained personnel.

One of our large electric companies has long made it a practice to hold regular Sunday drills in handling anticipitated disturbances. It is understood that the results have been most gratifying. While it is imposible to estimate the saving thereby effected, it is undoubtedly large. The practice is worthy of application to all power plants.

During the war woman proved her capability in almost every industrial pursuit, and her services during those strenuous times were welcomed. However, it was not long after the signing of the armistice that she began to find herself being crowded out of her newfound sphere by her brother worker. Although this condition to a limited extent prevailed in this country, it was of far greater magnitude in England and continental Europe. As a result there has recently been formed in London a Women's Engineering Society. Information as to whether this society is a trade union or an engineering society, as we know such bodies in this country, is not available. However, what such a society will develop into only the future can show.

There are still hopes that the real coal profiteer will be apprehended and given his just deserts. The men who run the price of coal up beyond reason by successive sales of the same coal with large profits on each sale are, it has been announced, to be the subjects of the newest campaign of the Attorney General against coal profiteers. Those that pay the high prices are patiently waiting to see something happen other than the price of coal go higher.

CORRESPONDENCE

Roof Condensation

For three years we had trouble with roof condensation, as mentioned in the editorial in the Aug. 31 issue of *Power*. We overcame this trouble as follows: Our engine room is 26 x 44 ft. with concrete walls and corrugated iron roof. We have 100 ft. of 2-in. pipe on the cold side of the room. On cold nights and Sundays we turn steam in these so that the oil cups will feed freely in starting mornings. After running about an hour, when the engine room begins to get warm, we shut off the heat; on very cold days the heat remains on.

If the roof drips or if it rains, we open the windows to lower the temperature. One window in the peak of the wall, which is opened and closed by ropes, is all we find necessary to stop sweating. PETER BURKARD.

Gladstone, Mich.

To Prosecute Coal Profiteers

In the Aug. 31 issue of *Power*, page 354, is an item stating that the Attorney General instructs all District Attorneys to investigate and institute prosecution in cases where unreasonably high prices have been exacted in the sale of bituminous coal. In the editorial entitled "Who Gets It?" on page 400 of the Sept. 7 issue, it is stated that the Public Service Corporation of New Jersey is paying $14 a ton for coal, that Mayor Creamer of Lynn, Mass., says that the coal dealers would sell quantities of coal at $16 per ton, and that Admiral Benson, chairman of the Shipping Board, is quoted as saying that the board is paying from $18 to $20 per ton for bunker coal at Atlantic and Gulf ports.

What does the Attorney General assume to be an unreasonably high price? If $14, $16, or $18 to $20 a ton for coal is not a high price, what would be considered such? It is quite evident that the readers of *Power* would like to know if the Attorney General purposes to investigate the dealers who are charging such prices and what he intends to do when he finds that they are. As a matter of fact, the general public has lost faith in any statement regarding proposed investigation of high prices, because such statements have been issued for the last three or four years and nothing has come of them.

To the best of my knowledge, the reason that there has been a reduction in the price of any commodity has been mainly the fact that the banks have withdrawn their credit and the holders of various merchandise have been forced to put it on the market in order to clear themselves financially. This seems to have been the case largely in the matter of clothing and shoes, but it would appear that the coal operators are not depending so much upon the banks for capital, or if they are, the banks are being lenient with them. Furthermore, with coal selling at around $9 a ton at the mines, the operators could afford to pay a pretty high rate of interest to banks out of the excessive profits that they must be making over the cost of production.

No engineer believes that it costs $3 or $4 to produce a ton of coal at the mines, and if it does no one will believe that the operators are not charging a price that will put them under the heading of the Attorney General's letter; that is, that they are charging unreasonably high prices for bituminous coal.

There may not be a conspiracy between operators regarding the upholding of coal prices, but it looks as if such a situation existed and that if they were all put in a bag and shaken up one would be just about as guilty as another. Engineers who are using bituminous coal for fuel would like to see the Attorney General's letter produce results, but few, if any, have any hope that it will. J. W. WILBUR.

New York City.

Has the Public a Right to Know What It Costs to Mine Its Coal?

The editorial on page 399 of the Sept. 7 issue of *Power* under the title "Has the Public a Right to Know What It Costs to Mine Its Coal?" would be answered by an emphatic yes by the men who burn and pay for it. The latest quotation of bituminous coal at the mines is $8. The quotation showing the average price per ton realized at the mines as published in its editoral was, in May, $3.31. Therefore, in a period of four months, the price realized at the mine has advanced from $3.31 to between $8 and $9.

No sane man will attempt to make the statement that the increased cost of production is responsible for this rise in the price of coal at the mines.

Early in 1914, if the coal producer obtained $1.25 per ton for coal at the mines, he was getting a high price. By the experts who have so profusely given figures regarding the reason for the advance in the cost of practically everything, we are told that the production cost has increased 100 per cent. If this is true of the average commodity, it is doubtless true regarding the production of coal, but even then it does not give a justifiable reason why the price of coal should be between $8 and $9 at the mines as at present.

One reason that would doubtless be given for prevailing prices is that the producer can obtain such a price, which conditon is brought about by the scramble

of all coal users to get in a winter's supply, and everybody is doing it at once. It is to be hoped that the bottom will fall out of the market some time, but there is no evidence that it will do so until a permanent restriction is placed upon the tremendous amount of coal that is to be exported, if newspaper reports are reliable.

Quotations show that steam coal at tidewater is bringing from $12 to $15 per ton. In a recent conversation a coal dealer in the vicinity of New York City stated that, while he dealt only on a small scale in bituminous coal, he knew of instances where $18 per ton was being paid.

It is to be hoped that the Federal Trade Commission will be able to enforce its demand that information regarding the cost of producing coal will be made public, but it is doubtful. Furthermore, when coal operators are receiving $8 or $9 a ton for the coal at the mines, it is to be expected that they will do everything in their power to prevent the public from knowing what it costs to mine a ton of coal. J. W. EDWARDS.

New York City.

Where Should the Beginner Start?

The discussion that has been carried on regarding the question as to where a beginner in a power plant should start, hinges largely upon the mental and physical qualifications of the candidate for the engineering job. It would be useless to start a man in an engine room with the idea of making a competent engineer out of him if he were the sort of person referred to by C. F. Dewey, on page 402 of the Sept. 7 issue, where he states that a man had been on the same job for twenty years and could not put in a gage glass. Truly, such an individual will make a sorry specimen of an engineer.

On the other hand, there are many mechanically inclined men who have stepped into power plants as engineers without having had any extended previous experience. Of course, this cannot be done now under the license laws that are in force in various cities and states, but it goes to show that the man who is determined to become an engineer will do so, regardless of where he starts.

Taking my own case, for instance. Something like twenty years ago my ambition was to become a stationary engineer. My only experience had been two weeks' service nights without pay with the engineer of a small electric-lighting station in order to get an idea of how a plant was operated. In those two weeks, sometimes coming in on the day shift, I learned how to wash boilers, how to fire after a fashion, and gained a little knowledge in the operation of a steam engine and alternating generator.

After the two weeks' course in engineering, application was made for the position of engineer in a small electric-light station, and the position was secured. Therefore, with, you might say, practically no previous experience, I became a full-fledged engineer, having charge of two 90-hp. boilers, one 200-hp. Corliss engine and three direct-current generators.

No difficulty was encountered in operating the plant, although there was plenty to do, as it was in a run-down condition. And although it was not operated as efficiently as it could have been under a competent engineer, the residents of the town maintained that the service was better than it had been for years and the kerosene lamps that used to adorn the shelves of the stores handy for instant use, gradually disappeared. Since that time some years' experience has been obtained in both the engine and boiler room, but the chances are, had I started in the boiler room, it would have taken several years before I would have had a chance to hang up my hat and coat in an engine room.

In a certain plant in Ohio the practice with the chief engineer is to take men who seem to possess certain qualifications and place them in the boiler room, many times starting as coal heavers, advancing to firemen, and if they show the proper qualifications they are sent into the engine room. As a matter of fact, eight or ten men have been advanced from the boiler room to higher positions, and as the company operates several power stations, the men are frequently taken from one power plant to another, each time going to a better position.

If this were the practice in the majority of power plants, the argument that a man should start in the boiler room, if he is to become an engineer, would hold good. But in the majority of cases, if a man proves himself to be a good fireman the chief engineer is likely to keep him at that work rather than to advance him and run a chance of getting another fireman who would not prove as good.

Most engineers will agree with Mr. Dewey regarding the practice of employing illiterate and ignorant foreigners as firemen. I remember some years ago going into a boiler plant and upon asking a question of the fireman found that he could not understand what I was saying. Not one of the five firemen employed in that plant could speak English. They were under a chief fireman who held a license and was American born. It would seem that a boiler room operated with such men would be considerably handicapped, especially as in case of an accident, foreigners usually become excited and lose their self-possession in case anything goes wrong.

It is safe to say that nine-tenths of the big engineers of today—that is, the chief engineers in medium and large-sized plants—started in the little two-by-four, so-called, years ago and that very few of them began their careers in the boiler room.

On shipboard, as I understand it, the boiler room is in charge of one of the lower-grade engineers, and it will be found in many of the larger plants that the chief fireman is a graduate from the engine room.

In my opinion the place for an engineer to start on his career is in a small plant where he will run the engine and also do his own firing. W. A. REYNOLDS.

Springfield, Mass.

Pit Holes in Feed Pipe

We are having trouble with small holes coming in the feed-water line between the heater and the boiler. In fact, we have had this trouble for a long time. The heater is of the closed type, and the temperature of the feed leaving it is around 190 deg. We have used black and galvanized pipe on this line, but within a few weeks after putting it in small holes will eat through the piping on the upper side of the horizontal run. No holes appear in the vertical lengths.

What causes the pipe to pit, and what can be done to remedy the trouble? I don't care for theories, but if any engineer has had the same trouble and can tell me how to overcome it, an act of humanity will have been done. The water used is highly pregnated with lime.

Ottumwa, Iowa. J. A. WALLACE.

Side Slip of Crankshaft Caused Thump

Mr. Cultra's letter regarding trouble with split eccentrics, on page 475 of the Sept. 21 issue of *Power*, reminds me of a similar incident of an engine shaft slipping endwise with its resulting thump.

This was on a 125-hp. four-valve engine running at 98 r.p.m. and carrying a 12-ft. diameter flywheel. Every few revolutions there would be a dull thud, and its regularity indicated that something was out of order. What made it all the more puzzling was that the thud was out of time with every other movement of the engine.

Time after time the engine was examined, but the cause of the pound was not discovered until one day, while standing in front of the flywheel, I noticed that it made a sidewise movement, which was accompanied by the familiar thud.

This solved the mystery, and upon shutting down at noon a 4 x 4-in. timber was used as a lever against the rim of the flywheel to force the crankshaft toward the outboard bearing. Upon stopping it was found that there was a ¼-in. space between the eccentric and the inside of the pillow block, the eccentric acting as a collar to keep the shaft in place. The eccentric had gradually been forced away from the pillow block with the result that the shaft would run with the eccentric against the pillow block for a few revolutions and would then work away only to come back with a thud.

Setting the eccentric over against the bearing removed the cause of the thud, but as Mr. Cultra says, referring to his instance, had there been a shoulder turned on the shaft to fit against the end of the bearing, the eccentric would not have moved away from the bearing.

A. C. WATERS.

Boston, Mass.

Indicator-Test Diagrams

The accompanying indicator diagrams were taken on a 16 and 32 x 36-in. Corliss, double-ported valves, cross-compound condensing engine, running 120 r.p.m. About

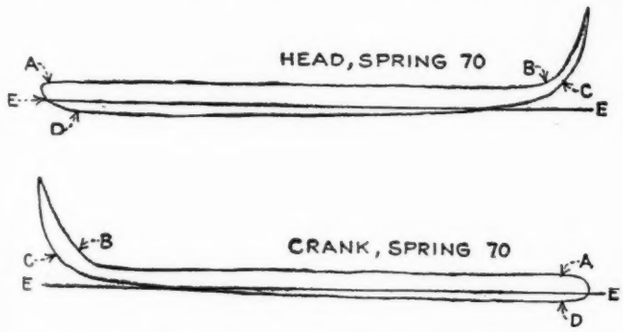


FIG. 1. DIAGRAMS FROM HIGH-PRESSURE CYLINDER, STEAM VALVES HELD CLOSED

half load was on the engine at the time, and several minutes elapsed between the taking of each diagram.

As each diagram was taken, the steam valve on the end being indicated was kept closed by preventing the latch-block to engage, thus cutting off the admission of steam to the cylinder.

The idea of taking diagrams in this manner was to test the valves and piston for leakage. Referring to Fig. 1, *A* represents the instant the piston is at the extreme crank end of the cylinder with the exhaust valve open to the receiver and the full receiver pressure, about eleven pounds in this case, against the piston, retarding its movement toward the head end. *B* is the compression curve, *C* is the expansion curve, and *D* is the point at which the exhaust valve again opens. *E-E* is the atmospheric line. The letters on the diagram shown by

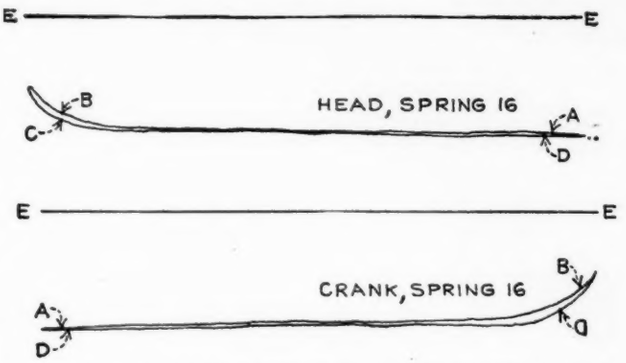


FIG. 2 DIAGRAMS FROM LOW-PRESSURE CYLINDER, STEAM VALVES HELD CLOSED

Fig. 2 represent the same events. I consider the valves and piston tight. Any criticisms of these diagrams will be welcomed.

GEORGE B. LONGSTREET.

Medford Hillside, Mass.

Diesel Cylinder-Head Gaskets

In a small plant containing two 170-hp. Diesel engines the heads had cracked and had been welded. The welded portion, on cooling, became somewhat warped. These warped surfaces gave a great deal of trouble by leaking. It was impossible to tighten down on the regular copper gasket sufficiently to prevent this leak.

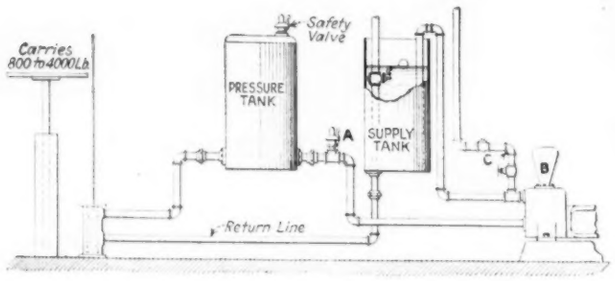
This was overcome by using No. 6 copper wire. The bare wire was cut with taper ends and was placed so that the ring pressed along the outside edge of the gasket groove. After the copper ring was placed, a small asbestos rope was placed alongside of the copper gasket, and the two were then lightly coated with red lead. After the head was set on the cylinder, the nuts were tightened down in the usual way. The copper wire can be drawn down a great deal and easily conforms to any unevenness of the joint. The asbestos rope and lead, being on the inside of the joint, will collect small carbon particles and thus will stop any small gas leak. This method has never failed to make a tight joint. When a new gasket has been placed it should be tightened up again after the engine has been in operation a short time. This should be done while the engine is still hot.

Some time ago, in another plant, a Diesel head gasket started blowing. The chief engineer shut the engine down and pulled the head. There was no extra gasket in stock, so the old one was cleaned and used again. As soon as the engine was started, the gasket started blowing again. Just as the engineer was about to pull the head again, the superintendent showed up and suggested an experiment. All the nuts were loosened except the two over the place where the gasket leaked. These two were sledged up as much as possible. The two adjoining nuts were then tightened; the remainder were tightened in rotation. The engine was started and ran without any leak showing. This is not the best of practice, but can be used in an emergency.

Brenham, Tex. W. A. DARTER.

Pound in Hydraulic Elevator System

The illustration depicts a hydraulic elevator system in operation at the plant where I am employed, and shows changes made to do away with pounding and groaning in the duplex pump. The pump had an air chamber and the safety valve was on top of the pressure tank. When lifting a heavy load on the elevator (located about 300 ft. away) through a 2-in. pipe the



ELEVATOR SYSTEM AS NOW PIPED

pump would pound at times so hard that it could be heard some distance from the engine room.

We tried setting the valves of the pump according to the theory of lost motion, but this did not remedy the evil. We removed the safety valve from the pressure tank and placed it on the pump discharge line at *A*, thereby causing a more steady and constant working of the reducing or regulating valve on the steam end of the pump. Before this change was made, the safety valve would blow off frequently.

We next removed the air chamber *B* and drilled a hole in the intake pipe *C*, for a ¾-in. pipe with a check valve in the line to regulate the amount of air taken in. The check valve is intended to keep the water from flowing out of the pipe if the elevator valves happen to be left in a partly open or closed position at the end of the day, so as to cause a blow back into the supply tank. This ¾-in. air pipe has removed all the pound in the system, except at times when the valve must be regulated for the proper amount of air in the pressure tank.

C. W. FIELDS.

Kent, Wash.

Pounding in a Semi-Diesel Engine

We have a 25-hp. Fairbanks Morse type Y semi-Diesel oil engine, also a 25-hp. kerosene engine. Each of these engines is belted to a 220-volt direct-current generator. On the peak load we carry about 210 amperes, which is above the engine ratings.

Our 25-hp. type Y engine runs very nicely when carrying up to 60 amperes. But from then on it begins to pound more or less. In fact, of late it is pounding more than usual. I am at a loss to fully understand the cause of the trouble. It must be either the fuel pump or the governor which is responsible.

As the load increases, the engine seems to smoke more than it should, and then at other times there will be but little smoke noticeable. About every three to four weeks the engine smokes terribly and the exhaust pot catches fire and burns out. These things then become normal for awhile. At present, though, the smoking is of everyday occurrence. I have felt that the fuel-injection pump might be throwing too much oil.

I have the mechanical oiler throwing more lubricating oil than usual; I have set the ratchet to feed a stream every 2½ seconds. This seems to allow the engine to carry a heavier load. I thought for a time that the excess lubricating oil caused the smoke.

What is the cause of the heavy smoke or the terrible pounding? Why does the engine die down then? When it dies down, all we do is to light the torch again and the engine starts running just as if nothing had happened. A person inexperienced with this engine would bet that every bearing was being knocked loose. I would welcome any information *Power* readers can offer.

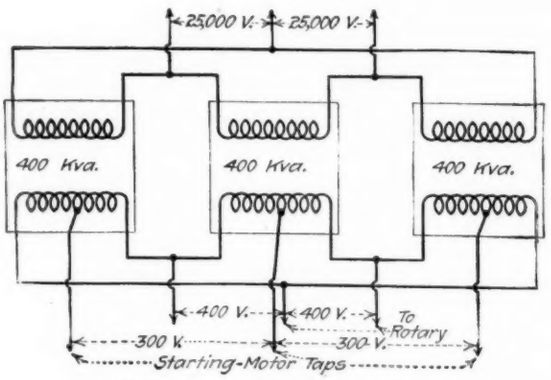
Winside, Neb. A. S. GABLER.

[*Power* will be glad to publish any communications from its readers offering a solution of Mr. Gabler's problem.—Editor.]

Open Circuit in Transformer

A substation supplying power to a particular district was thoroughly gone over in anticipation of a heavy load and was supposed to be in shape to handle loads up to 50 per cent over rated capacity. The rotary-converter transformers were cut out of service at midnight, and several electric fans were grouped about the bank to cool them down as much as possible before starting time in the morning.

The transformers were 3 single-phase 400-kva. units connected in closed delta, as in the figure, and stepped down from 25,000 volts to 400 volts, with percentage taps brought out to the rotary-converter starting motor. In the morning the transformers were cut into service and the rotaries started up. At the time of starting they were cold, but as the load increased they warmed



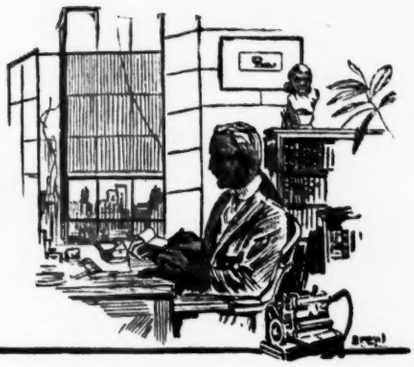
CONNECTIONS OF TRANSFORMER BANK

up slightly. However, it was noticed that the temperature of one transformer was not increasing, while that of the other two was. This condition held throughout the day. The fans were removed from the cool transformer and turned on the other two to assist in cooling them.

At night the cool transformer was cut out of service, and upon raising the core out of the case it was found that a connection between two sections of high-tension coils had burned in two, thus cutting the transformers out. In regard to the starting motor taps, the damaged transformer acted as an auto-transformer and the other two operated on open delta, thus giving three-phase current to start up with.

Pittsburgh, Pa. M. A. ANDERSON.

INQUIRIES OF GENERAL INTEREST



Repairing Piston Fire Cracks—I have a 100-hp. oil engine that has a fire crack in the piston head 8 in. long. Should I use cast or wrought brass to "sew" it? J. M. T.

It is necessary to use wrought brass since the cast brass will not admit of good riveting and will not stand up under the high temperature conditions.

Oil in Semi-Diesel Engine Exhaust—Why does my 50 horsepower semi-Diesel have a continual stream of oil dripping out of the exhaust, and how can this be remedied? E. S.

Not knowing all the conditions, it is natural to assume that you are running your engine with the hot ball too cold or the fuel nozzle leaks oil into the engine late in the stroke. The remedy is apparent.

Feeding Boiler Compound—We are annoyed by clogging of valves of our boiler-feed pump from drawing soda-ash solution through the pump suction. How can this trouble be prevented? W. H. V.

A boiler compound or scale solvent should be introduced from a boiler-compound feeder discharging through a T in the feed line between the pump and boiler, and with special watchfulness to guard against stoppage of the feed line or impairment of operation of the stop and check valves or other fittings.

Casehardening Pins of Roller Expander—How can the pins of a roller expander be casehardened? F. A. K.

A quick process of casehardening small articles, like expander pins, is to plunge the part at bright-cherry heat into a box containing cyanide of potash crystals and then quench the piece at a dull-red heat. Cyanide is a deadly poison and should be handled accordingly. The operations of casehardening should be performed in the open air, the operator taking his position on the windward side of the cyanide, with care not to inhale or expose his eyes to any gases or vapors formed in carrying out the process.

Water Level Equalization Impractical—How can equalizer pipes be arranged to obtain uniformity of water level with a single-feed stop valve in a battery of high-pressure boilers? C. L.

Equalizer pipes of reasonable size cannot be depended upon for maintaining a uniformity of water level. This can be appreciated when it is considered that one inch difference of water level would result for a difference of only 1/27 lb. per square inch of pressure of steam generated, or from variation in loss of head of only 1 in. water-column pressure for overcoming the friction of flow in the equalizing connections.

Relative Efficiency of Injector—Is an injector as efficient as a reciprocating engine? H. K.

Considered as a pump, the mechanical efficiency of an injector is very low, amounting to only 1 to 2 per cent, whereas the mechanical efficiency of steam engines is from 50 per cent for small reciprocating engines to 97 per cent for the best pumping engines, depending on their design, construction and method of operation. When used for feeding water direct to a boiler, the injector has a thermal efficiency of 100 per cent less the trifling loss due to radiation, since all the heat not converted into work is carried into the boiler, whereas small direct-acting feed pumps, without utilization of the exhaust in a heater, give an efficiency of only about 50 per cent.

No Advantage Raising up Submerged Centrifugal—A centrifugal pump is operated submerged for raising water to a height of 75 ft. above the pump. Will the head pumped against and power required be reduced by raising the pump 8 feet? W. T.

The pump must operate against a pressure which is equal to the pressure due to the head above the pump, plus pipe friction, minus the pressure due to the head of the section water above the pump. This difference would be unchanged by raising or lowering the pump, excepting in the small difference of pipe friction due to variation in length of discharge pipe. Therefore, raising the pump and pumping at the same rate would require practically no less power for raising the water to the present elevation above the level of the suction water.

Designations of Pressure—What is the difference between absolute pressure, boiler pressure and gage pressure? J. B. S.

Absolute pressure is the total pressure above a perfect vacuum. Boiler pressure is the pressure resisted by the strength of the boiler, hence boiler pressure is absolute pressure less the exterior pressure of the atmosphere, or, as commonly expressed, is the pressure above atmosphere. The pressure of the atmosphere acts on the exterior of a gage tube or a diaphragm just as it acts on the shell of a boiler. Ordinary pressure and vacuum gages indicate 0 for the same pressure on both sides of tube or diaphragm, and the dial is laid off to indicate pressures above or below the pressure of the atmosphere, hence "gage pressure" means the same thing as "boiler pressure."

Crediting Value of Waste Heat Supplied to Boilers—Our boiler plant is completely equipped for oil burning, and some of the boilers are operated most of the time with heat obtained from waste gases of metallurgical furnaces; but at intervals it is necessary to operate the whole plant with fuel oil. How can the monthly service of waste gases be credited to the furnaces in terms of barrels of fuel oil saved? R. G.

To evaluate the service, it would be necessary to determine the total number of pounds of water evaporated per month by the boilers when supplied only with waste gases, reduce the evaporation to equivalent evaporation from and at 212 deg. F., and ascertain the equivalent evaporation from and at 212 deg. F. for the same boilers when operated as nearly as possible with the same average output, using oil as fuel. The evaporation per month using waste gases divided by the evaporation obtained per barrel of fuel oil will give the number of barrels of fuel oil to be credited.

[Correspondents sending us inquiries should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications.—Editor.]

N.A.S.E. Annual Convention at Milwaukee

THE biggest and best ever was the verdict of those attending the thirty-eighth annual convention of the National Association of Stationary Engineers, held in Milwaukee Sept. 13-17. The attendance was large and enthusiastic, and the proceedings of the convention were conducted with businesslike dispatch on schedule time. Credit is due the local committee for attention to detail. The auditorium made an ideal place in which to display the great variety of power-plant products, there being 274 booths, and to hold the business sessions and the entertainment that had been provided.

At the opening session Tuesday morning Charles F. Bindrich, chairman of the local committee, presided. There were the usual speeches of welcome and responses by officials of the association. President Calahan delivered an eloquent address upon taking the chair to open the convention officially. In his report the president called attention to the membership drive during the year, which had resulted in adding to the roster 1,500 members, and the formation of eight new local associations. The aim had been to place these new associations in localities where there would be a real chance for growth, so that they might prove to be prosperous and permanent organizations, adding to the support of the national body and giving a nucleus for continued growth in the future. Owing to the activities in the president's own state, New Jersey, his state had risen from sixth to second place in membership.

In his recommendations the president urged strong protest in regard to the discrimination against engineers in various government departments at Washington. It appears that a bill is now pending changing the title of engineer to "engineman," and prohibiting the promotion to the position of mechanical engineer or superintendent. The same restrictions would not be in force against electricians. The president objected to the appointment of a national educator, urged by the Educational Committee, as in his opinion there was enough talent in the organization to conduct the work successfully along the same lines as in the past. Later on the convention concurred with his opinion. He favored the appointment of a special committee to choose the convention city, requested authority for the incoming president to appoint a committee to carry on the membership-extension work, providing them with a fund of $3,000 to cover expenses, and was in accord with the agreement drawn up by the engineers and exhibitors to govern their working relations. This agreement was approved later by the convention.

Reports to the secretary from 231 associations showed that the membership totaled 20,721. Finances were reported to be in a flourishing condition. The income during the year of $44,488.44 was the largest on record. The License Committee had been active and had succeeded in establishing local license ordinances in Racine and Stevens Point, Wis., and Wilmington, Del. A comprehensive bill is now pending in Baltimore. To improve the efficiency in this work, it was recommended that a committee of five be elected, the term of office to be five years, with one member retiring at the close of each annual convention.

DELEGATES AND THEIR GUESTS ATTENDING THE THIRTY-EIGHTH ANNUAL CONVENTION

The Membership Extension Committee reviewed fully their work of the past year, outlined a plan of action for the coming year and recommended an appropriation of $3,000 to carry on the work.

Correspondonce received by the Power Plant Cost Committee had convinced them that accountants pay little attention to cost details and their separation into unit charges. They are interested principally in the cost of heat, light and power as a whole, so that in their reports engineers should be guided accordingly. To promote greater interest in the keeping of accurate operating costs, the committee suggested prizes for the systems giving the best results, details to be given in articles appearing monthly in the *National Engineer*.

Among the referendum proposals appeared a resolution to change the name of the association by eliminating the word "stationary." Its use had created a false impression before the public. In any event the profession had become so diversified that this word did not designate properly. It was realized that legal difficulties would be encountered, so a committee was appointed to investigate thoroughly and report their findings to the 1921 convention.

Another matter for referendum was the increase of the mileage rate to delegates. The balance in the treasury

after all expenses have been paid is to be divided among delegates pro rata, according to the number of miles traveled, but in no case to exceed ten cents per mile one way.

As is customary, the National Ladies' Auxiliary was received by the convention and was granted the usual donation of $100. It had been a banner year for the ladies as donations had totalled $4,374. The annual memorial service was impressive. On the roll were 186 members of the organization. Associations winning flags for appreciable gains in membership were more numerous than usual, 55 being entitled to the honor. The Life and Accident Department reported the payment of 59 claims amounting to $29,500, a reserve fund of $5,059.57 and a membership of 3,341, representing a gain of 23 members during the year.

As has been the practice of the past few years, reports were presented in abstract to give time in the convention for technical papers and welfare discussion. This year

OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS AT MILWAUKEE, WIS.

three papers were read. One entitled "The Progressive Engineer," by H. P. Wilder, traced the development in the field, the progress that had been made in the profession and enumerated the qualifications that a progressive engineer should have. In a paper on "Science and Engineering," Prof. B. G. Elliott urged the necessity of engineers becoming familiar with the fundamental laws on which engineering is based, as their tasks were daily applications of these laws. The speaker showed how simple these laws really were and suggested that the time had come for the association to adopt a stronger educational plan. Dabbling here and there in one subject or another did no good. Consistent courses followed through under the supervision of an educational director was the plan to be recommended.

"Capacity and Maintenance," by Charles A. Cahill, was the third paper. Because central stations generally worked equipment to the limit during the peak load to hold down investment and consequently overhead, he did not believe that such practice should be adopted generally by industrial establishments. The results were excessive maintenance costs and, with troubles continually piling up, a demoralized operating force. It was his opinion that the size of units should be proportioned to the capacity of the station, and that all equipment should be operated at the point of highest efficiency. Money should be appropriated yearly to keep the plant in strong operating condition. An engineer who has foresight to anticipate and correct beforehand is worth five times as much as one who can patch a thing up after it smashes through neglect. So-called improvements should be carefully weighed to make sure that they will bring adequate returns. Present high prices called for careful work in the power plant and an adequate system of records, and those who wish to attain the highest possible success will do well to devote more attention to human engineering.

Entertainment consisted of a smoker Tuesday evening moving pictures of Milwaukee industries on Wednesday evening, annual entertainment of exhibitors Thursday night, Friday night being given over to the closing feature, the grand ball. There were daily band concerts in the exhibition hall, and Wednesday afternoon was given over to the annual field day, at which horse racing and the ball game between engineers and exhibitors were the leading attractions. Inspection tours to the works of the Allis-Chalmers and Nordberg companies were arranged, and groups were daily given the privilege of inspecting the powdered coal plant at the Oneida Street Station. John Anderson and Mr. Kreisinger of the Bureau of Mines were in attendance to explain and comment upon the operation. Engineers to the number of 700 were taken through the plant, and all seemed to be favorably impressed.

Officers for the ensuing year are: Alfred Johnson, president; R. W. Parry, vice president; Fred Raven, secretary; S. B. Forse, treasurer; Harold R. Hilton, national trustee; J. Albert Johnson, conductor; Frank S. Guth, doorkeeper. Dad Beckerleg conducted the installation services.

Rochester, N. Y., was chosen as the next convention city.

At the business meetings of the National Exhibitors' Association discussion turned largely to the new working agreement that was to guide their relations with the N. A. S. E. The following officers were elected: F. N Chapman, president; Frank Martin, vice president; A. W France, treasurer; Hudson Dickerman, W. L. Schaefer E. E. Jones, L. E. Hilton and G. E. Rowland, executive committee.

The newly elected officers of the Ladies Auxiliary are: National president, Mary E. Lamb, Pittsburgh, Pa.; vice president, Catherine Bastain, Chicago, Ill.; secretary, Lenore W. Farmer, Columbus, Ohio; treasurer, Mary T. Mahon, Chicago, Ill.; conductor, E. Florence Kimball, Boston, Mass.

Chemical Society Fuel Symposium

TWELVE papers were presented on September 9 before the American Chemical Society in the form of a fuel symposium. Four major topics were discussed by the various speakers: (1) Carbonization of Coal; (2) liquid-fuel problems, particularly gasoline; (3) the general problem of fuel conservation, and (4) the problem of sulphur in fuels. This session aroused a great deal of interest because of the widespread attention being given to fuel matters and urgency of fuel supply in industry at the present time.

Low-Temperature Carbonization

S. W. Parr presented a discussion of low-temperature carbonization by which he meant treatment of fuel at temperatures below 800 deg. C. He indicated that up to this temperature he considered essentially only primary products of distillation; secondary products of high-temperature decomposition do not enter materially until higher temperatures are reached. The usual method of rating coals as to cokability depending upon the ratio of oxygen content to hydrogen content is criticized by this author. He pointed out that conditions of treatment of the coal were of greater importance than this ratio, for if temperature is properly controlled, the interaction of the oxygen compounds with those compounds which afford the binder for the coke is prevented. He presented one example of a coal badly weathered which was still suitable for coke production by proper temperature control. He advanced the theory that those constituents which are soluble in phenol react upon heating with oxygen compounds to give compounds of variable composition and prevent coking. He emphasized particularly that the sulphur, nitrogen and oxygen compounds formed seemed to violate the laws of definite compounds, as the percentage composition of these compounds varied by small steps in a way inconsistent with our usual concept of definite composition.

Because of the low heat conductivity of the coke mass through which heat must have been transfered by ordinary systems of coking, this author has undertaken to use the exothermic heat of reaction during coal carbonization to furnish the bulk of the heat required for coking. He refers to the reactions thus as proceeding "autogenously." He expresses two of his conclusions in this particular as follows:

It is possible to utilize the exothermic reactions inherent in high-oxygen coals in such a manner as to secure the autogenous transmission of heat to the center of an otherwise non-conducting mass and under conditions wherein the ultimate temperature attained at any point of the coal mass is not in excess of the prescribed limit.

The time for autogenous heat transmission is governed by the speed of the exothermic reactions involved and is estimated to be approximately one-fourth of the time required for heat penetration as obtained under high-temperature conditions.

At the present time Dr. Parr has not proposed any definite industrial processes, but is working on a basis of a discontinuous operation with 35-lb. samples; that is, on a commercial laboratory scale.

Carbonization of Lignite

A paper entitled "Carbonization of Canadian Lignites," by Edward Stansfield, was presented by Mr. French, the engineer who has been associated with this investigation, covering the work done jointly by the Department of Mines and the Lignite Utilization Board of Canada. This report described the early small-scale experiments and the later larger-scale tests which have led up to the design and construction in Southern Saskatchewan of a plant which is expected to handle two hundred tons of raw lignite per day. The lignites used are available at about $1.75 per ton at the mine. A typical analysis of the material employed, on a moisture-free basis, is as follows: Water of constitution, 31.8 per cent; volatile, 28.9 per cent; fixed carbon, 34.1 per cent; ash, 5.2 per cent. The heating value is approximately 4,260 calories per gram. From this material the following results are reported.

	Percentage of Weight of Dry Coal	Per Cent of Original Heating Value
Water	11.7	....
Gas	17.0	8.3
Crude tar	4.1	6.0
Residue (char)	66.7	78.1
Loss	0.5	7.6

These represent yields of about 3,150 cu.ft. of gas having a heating value of 385 B.t.u. cu.ft., 5.3 gal. of tar, 910 lb. of residue, and 10.2 lb. of ammonium sulphate per ton of dry lignite treated. The process is developed to a point where the tar is distilled and the pitch from this used as a binder for briquetting the char. The principal object of this work is the development of a solid fuel, therefore less effort has been made upon gas and byproduct recovery thus far. The commercial plant is nearing completion, and it is hoped that operations will begin within a few months.

As a contribution to the discussion of this report, E. P. Schoch, professor of the Department of Chemistry of the University of Texas, presented a discussion upon the utilization of Texas lignites. The effort in this work was to obtain a supply of city gas, and the tendency was, therefore, along different lines from those described in the Canadian work. Special attention was given to operation of the retorts under pressure. It was found that this gave a higher yield of gas but at the expense of a lower yield of tar. This result was probably caused by the slower elimination of the vapors from the retort causing a greater cracking and, therefore, larger gas yield from the otherwise liquid constituents.

The large percentage of carbon dioxide in the gas led to a special effort looking to the removal of this constituent. As a result liquid purification was adopted and very favorable results are reported. From 2,000 to 3,000 cu.ft. of gas per ton of raw lignite was thus obtained with a heating value in the gas approaching 600 B.t.u. per cubic foot. The yields of coke and tar were of the same order as those reported on the Canadian material.

The advantages claimed for the method of handling recommended were: Coke of a good heating value, gas immediately usable for city supply, maximum yield of tar, a cheap retort of large capacity operating under conditions that make for long life, and the production of coke easily handled in briquetting.

Fuel Conservation

H. C. Porter discussed the general subject of present and future conservation of fuel supplies. Among the means of increasing our fuel resources he suggested the following: Increased use of boiler-plant accessories such as feed-water heaters and other efficiency devices; use of gas instead of coal in steel plants; electrification of railways; development of super-power electric stations; carbonization of coal at the mine; increased carbonization with recovery of byproducts; alternate carbonization and steaming of coke in a single machine for production of a mixture of coal gas and blue gas; use of oxygen to enrich water-gas blast (the oxygen to be made with power used at off-peak hours); a lower heating value per foot for city gas supply; elimination of beehive ovens and other well-recognized means of fuel economy.

Byproduct Coking

F. W. Sperr, reviewing the byproduct coke situation, summarized the present status of work in this field. He emphasized particularly the trend toward byproduct gas manufacture and away from the production of water gas. The lesser labor requirement per ton of coal handled in byproduct ovens as compared with coal-gas plants handling the coal at smaller units is also a factor at present tending to increase byproduct oven operations. The relative economy of beehive and byproduct oven operations was emphasized, and the trend for many years past toward byproduct coke for blast furnace use was pointed out. It was urged

that further study should be given to additional applications of coke so that more of our bituminous coal could be handled with byproduct recovery. Utilization of coke breeze by stokers was pointed out as one important contributing factor to the success of coking at the present time. Other factors mentioned were producer gas firing of ovens, use of silica refractories in place of fireclay materials, the extensive application of tar as a metallurgical fuel, etc. It was pointed out that recent byproduct ovens provided for steaming of coke in the oven, thus arranging that almost complete gasification of the solid fuel may be accomplished in what is practically a single operation.

Gasoline Losses

A. C. Fieldner and associates reported upon extensive tests of motor vehicles for efficiency in gasoline use. These tests make clear the very large losses of gasoline which result from improper carburetor adjustment and careless driving. These tests were those carried out in connection with the investigation of poisonous gases from automobile exhaust which must be cared for in the proposed vehicle tunnel under the Hudson River.

J. B. Garner urged the use of natural for the enrichment of manufactured gas supplies, stating that in his opinion natural-gas companies should no longer be permitted to sell natural gas as such, but should conserve it for the city supply to supplement the manufactured gas production for these purposes.

Commercial Realization of Low-Temperature Carbonization

Dr. Harry A. Curtis, chief chemist of the International Coal Products Corporation, reported on the carbocoal process which has been developed to the point of the installation of a plant having a daily capacity of 350 tons of product, using 500 tons of coal per day. The general process is described by him as follows:

Carbocoal, as it is called, is a bituminous coal which has been changed into a smokeless fuel resembling anthracite. It is prepared by crushing the soft coal and carbonizing it at a relatively low temperature of 900 deg. F. The coal is carried out in a horizontal retort about seven feet in diameter and twenty feet long, lined with carborundum. The coal is continually stirred and moved slowly through the retort by means of paddles mounted on two heavy steel shafts running lengthwise the retort. Each retort has a capacity of about a ton an hour, the Clinchfield Plant being equipped with twenty-four of these retorts. Carbonization of the coal in this manner yields about twice as much tar as is obtained from the ordinary coking process, but the semi-coke obtained is quite soft and friable. It can be used directly under the boiler of a power plant or put into a gas producer, but is not in good shape to market as a general fuel for domestic and industrial use. In the "Carbocoal Process" the soft semi-coke is ground, briquetted with pitch, and the briquets then carbonized for about six hours at 1,800 deg. F. The effect of this high-temperature carbonization is to render the briquets hard, dense and smokeless—quite unlike any other fuel on the market. A further substantial yield of byproducts is obtained during the second carbonization, so that the "Carbocoal Process" represents a very economical method of producing a smokeless fuel from bituminous coal. The high yield of oils obtained is also of great importance in view of the rapidly diminishing supplies of petroleum in the United States and the enormous growth of industries which use oil products such as gasoline, motor spirits, lubricating oils and fuel oil.

Sulphur in Fuels

The report by Alfred R. Powell discussed the factors which affect the sulphur content of coke and of gas produced by the carbonization of bituminous coals. The significance of the different sulphur compounds in the coal upon the distribution of the sulphur in the products is pointed out.

The report on a similar subject was presented by H. F. Yancey and Thomas Fraser, entitled "The Distribution of the Forms of Sulphur in the Coal Bed." The relations between the relative quantities of pyrite sulphur and organic sulphur were discussed. This work represents a report of a large number of mine samples, particularly those collected in southern Illinois and western Kentucky.

Applications Filed with Federal Power Commission

Additional applications have been filed for preliminary permits and licenses with the Federal Power Commission as follows (the serial number, the date, the name and address of the applicant, the kind of application, the type of project works, the stream, the state and proposed use, are shown):

Western New York Utilities Co., Inc., Medina, N. Y.; preliminary permit; diversion of an additional 500 s.f. for power development, Erie Canal, N. Y.; public utility. Montana Water Power and Electric Co., Spalding Building, Portland, Ore.; preliminary permit; power project; South Fork of Flathead River at the outlet of Flathead Lake, Montana; proposed use not stated. Millard F. Bowen, 117 Tennessee Ave., Washington, D.C.; license; reservoirs, conduits, locks and power houses; Lake Erie, Niagara River and watersheds between Lake Ontario and the Hudson River, New York; navigation and power for unstated uses. A. P. Connor, Five Cent Savings Bank Bldg., Springfield, Mass.; preliminary permit; power project; Connecticut River; Massachusetts and Connecticut; proposed use not stated. Big Bend Power Co., care F. C. Moon, Lynchburg, Va.; preliminary permit; power project; James River, Virginia; proposed use not stated. Moore's Creek Boulder Gold Dredging Co., care Clinton H. Hartson, Boise, Idaho; license; transmission line; Idaho; to transmit electric energy to the works of applicant for use in connection with its mining operations. Grand Rapids, village of Grand Rapids, Minn.; preliminary permit; power plant at Government dam on the Mississippi River, Minnesota; municipal. City of Dothan, Dothan, Ala.; preliminary permit; power project, Choctawbatchee River, Alabama; municipal. W. T. Larimore, Leo E. Mills and Charles E. Bailey, Hugo, Okla.; preliminary permit; power project, Little River, Okla.; proposed use not stated. Washington Development Corporation, L. C. Smith Building, Seattle Wash.; preliminary permit; power and irrigation project; Dunganess River and West Fork Creek, Olympia National Forest, Washington; power and irrigation. Reed Bingham, Pensacola, Fla.; preliminary permit; power projects, Perdido, Styx and Blackwater Rivers, Alabama and Florida; proposed use not stated. William F. Scheffel, Wenatchee, Wash.; preliminary permit; power irrigation project; Columbia River, Washington; power and irrigation.

Increase in Freight Rates on Coal

General increases in the rate of transportation of coal on the railroads have occurred due to the recent advance in transportation rates allowed the railroads by the Interstate Commerce Commission.

The new coal tariff filed with the Interstate Commerce by the Baltimore & Ohio R.R. is typical of the situation. The new rate on coal from the West Virginia fields, from the Cumberland region to Baltimore, inside the harbor is $2.53 per ton against the old rate of $1.95 per ton. The new rate outside the capes is $2.53 against the old rate of $1.73. From the Fairmont mine group in West Virginia, the new rate via the Baltimore & Ohio R.R. to Baltimore, inside the harbor, is $3.18 per ton as compared with the old rate of $2.20, or an increase over the Cumberland rate of 25 cents per ton. For delivery outside the Capes, the new rate is $2.78 against the old rate of $1.98, an increase over the Cumberland group rate of 80 cents per ton.

The new rate on coal moving via the Baltimore & Ohio R.R. from the Finleyville district of Pensylvania to Baltimore, within the harbor, was given at $3.33 per ton compared with the old rate of $2.95, or an increase of 15 cents over the Fairmont group rate. The new rate on coal moving from that district for delivery outside the capes is $2.93 against the old rate of $2.13 per ton, or an increase of 80 cents per ton over the Fairmont group rate.

The new tariffs formulated by the Pennsylvania R.R. are practically the same as those of other carriers serving the same fields. New rates on coal put into effect by the Pennsylvania R.R. on tariffs originating in West Virginia, Maryland and Pennsylvania, moving through New York, generally show a 96 cents increase per ton over the old rate.

Instructions to Employees at Pumping Station and Filter Plants*

By DOW R. GWINN
President and Manager, Water Company, Terre Haute, Indiana

HUMAN nature is very much the same in Indiana and Illinois as it is in New York and Oregon. The tendency is to move along the line of least resistance—to do things the easiest way. There are cases where the easiest way and efficiency are not synonymous terms. In operating water plants the author has tried to find the best way of doing things and then to adopt them as standard methods, even if they are difficult, and hold to them until better ways have been found. After methods have been adopted, it is discouraging to find later on that they are not being observed by assistants. On inquiring why certain methods have been discontinued, the usual answer would be, "We don't do it that way any more," and further inquiry would not disclose why or when the method was discontinued.

The idea of printed instructions was then tried; it has worked very well. There is an advantage in having a particular time to do certain things, such as cleaning the heater, blowing down the boilers, taking indicator cards, making evaporation tests, etc.

The instructions are typewritten and are kept in loose-leaf binders. Change can be easily made, and additional sheets may be readily added. No method is so sacred that it cannot be changed by the manager. The employees are encouraged to suggest better methods, and when tried and found to be advantageous, they are substituted for old ones.

Each employee is supposed to read the instructions once a month; he may select his own time while on duty for the reading. A sheet of properly ruled paper is inclosed in the

THE TERRE HAUTE WATER WORKS COMPANY

1920

Names	Jan.	Feb.	Mar	Apr.	May	June	July	Aug.	Sept	Oct.	Nov	Dec.

file on which are the list of employees and each employee records the date when he reads the instructions.

The Terre Haute plant takes its supply from the Wabash River and is a direct pumping plant, there being no standpipe or elevated reservoirs which could be used if pumps were not in operation. For pumping into the distribution system there is a 10,000,000-gal. vertical triple expansion and a 6,000,000-gal. vertical compound pumping engine, also smaller pumps. For delivering to the sedimentation basin there is a centrifugal pump operated by a compound high-speed engine connected with a rope drive. Steam is generated in water-tube and fire-tube boilers with hand firing. A vacuum pump for exhausting air from the suction of the principal pumps is a part of the equipment. There are 22 mechanical pressure filters and a sedimentation basin with sufficient capacity for approximately two to five hours subsidence, used when the turbidity exceeds, say, 60 in the Jackson Turbidometer, or about 55 per cent of the time. The turbidity of the river water ranges from 25 to 3,000. The pumps work against 70 lb. domestic pressure and 125 lb. fire pressure. The available pressure at fire hydrants in business or high-hazard districts is 100 to 110 lb. While the fire department is equipped with pumpers, they are seldom used, the pressure from the plant being usually sufficient. There are 100 miles of main, 62 per cent being 8 in. and larger diameters, and 1,155 public fire hydrants. There are 8,240 consumers; 97.7 per cent of all service pipes are metered, including private fire lines for automatic sprinklers.

At the plant there is a program clock which summons the attendants every half-hour to examine the water; this is just a visual examination of the raw and filtered water, and a record of the appearance of the water is made. This is necessary because of sudden changes in the turbidity of the raw river water.

A record of fire alarms is kept, showing the length of time extra pressure is maintained, increase in pumping rate, time of receiving alarm and strike out; also hydrants used and condition after fire.

Inspectors answer alarms received from high-hazard districts during day and second alarms at night. Engineers and firemen are on duty eight hours; that is, they are off duty sixteen hours per day for six days and the seventh day they are off twenty-four hours.

Monday is change day, when each man moves up one watch, the duties during the eight hours being performed by other employees. The changes are made at 7 a.m., 3 p.m. and 11 p.m.

Employees are given two weeks' vacation with pay. Baths are provided for the men, also books on engineering, a file of *Power* and other technical publications. The grounds on which the station is located were laid out by a landscape gardener and are very beautiful. A fine tennis court is provided. Long periods of service are the rule, one engineer having recently completed thirty years of continuous employment. The company arranges and provides for an annual picnic on the station grounds for employees.

Instructions such as the following have been found to be satisfactory for the Terre Haute plant; and while they would not be suitable in every particular to any other waterworks plant, they may be suggestive and valuable to other operators.

The Terre Haute Water Works Company Pumping and Purification Departments

These instructions are to be read monthly and the date of reading recorded in the proper column.

Suggestions for the improvement of the service are respectfully invited.

No man can know too much about his work.

Please bear in mind that you are guarding the water supply of your home city.

Be faithful in the discharge of your duty.

General Instructions—These general instructions are not intended to take away the power and obligation of the employee to meet his work with personal judgment and efficiency, but rather to assist by such rules and suggestions as seem necessary and helpful.

Bear in mind that it is up to us to maintain the standard; that it is our duty to furnish good water every minute and adequate fire service whenever it is called for; that the manager is depending upon his fellow workers to do their part and that he has confidence in them; that in emergencies it is not a question of spending a few dollars in order to get results, for the standard must be maintained regardless of cost.

Fire Alarms (Engineers)—The big general thing to remember is to "play safe." That is, to consider the location of the fire and its probable or possible magnitude and to promptly take any action that may seem necessary to furnishing an adequate supply of water, at proper pressure and maintain the quality of the water. To this end it is better to take much precaution, such as notifying the chief engineer and the assistant chief, calling out an extra fireman or station helper, having fire lighted in extra boilers,

*Presented at the thirty-ninth annual convention of New England Water Works Association, Holyoke, Mass., Sept. 7-10, 1920.

getting an extra engine ready, etc., rather than fail in any particular because of lack of having done these things.

In case of a serious fire or general alarm, notify chief engineer and assistant chief engineer; if the fire is at night, notify general foreman; get Holly engine warmed up and ready for action; consider the matter of whether there are enough boilers in use and whether extra help is needed in boiler room.

Engine No. 5 for Emergency—Engine No. 5 is the quick-acting emergency and peak-of-load engine. This engine should be put into service at once in case of any trouble with Allis or Holly. No. 5 can be put under full load, if necessary, in one minute; the best way to handle the engine for this quick action is as follows: Both steam valves should always be left hooked up, then first crack throttle slightly, proceed at once to open water-injection valve, unlatch one steam valve and go ahead. Each engineer should practice handling the engine until he can safely and surely get under full load in one minute as stated.

Call Bells at Allis—The call bells in lower boiler room and in filter room, with control at Allis engine are intended for use of the engineer when wanting help and not wishing to leave engine; they will sound continuously until stopped.

Call Bell at Observation Sink—This bell may be answered and observation noted by the engineer, filterman, or helper who happens to be nearest at signal. Do not, however, record any observation unless you actually take it. Do not indicate as O.K. unless water is clear. Smoky water is not satisfactory. For instance, if you record an observation at 3 o'clock and notice a blank for 2:30 do not go back and record 2:30 as an observation. Any signals that have been missed must be left blank; if the observation signal is not operating properly it should be reported by the engineers to the chief engineer. A signal answered within five minutes after its stated time may properly be recorded.

Report Trouble or Unusual Occurrence—Any particular trouble or unusual occurrence at the plant in the absence of the chief engineer should be reported as soon as practicable by telephone to Mr. Taylor or Mr. Ranbarger; also a written report of the matter should be left by the engineer on watch for the chief engineer, before going off duty.

Suspicious Behavior of Engine—Any of the engines developing any trouble or suspicious behavior should promptly be placed under control of the throttle or shut down as may seem necessary. If placed under the throttle the engineer should signal filterman or fireman for assistance.

Coppus Blowers and Low-Pressure Alarm—These are to be tested out for operation each week and recorded on weekly report sheet with date of test. As a general rule, they will be tested and recorded by the assistant chief, but if for any reason he does not do so the engineer making out weekly report on Friday night will test and record same, signing his name.

Inspecting Recording Gages, Etc.—The engineer on watch will, immediately after coming on, inspect water-pressure gage on Allis engine and general condition of all machinery in operation; a little later he will inspect recording steam gage and tachometer chart for proper operation and also for proper time setting and record observation on daily report sheet. Engineers will sign tachometer records in spaces made while on duty.

In addition to taking revolution counters at midnight for the daily pumpage, the engineer on watch will take the counter on No. 7 at 2 a.m. and at 4 o'clock each morning and record the average r.p.m. for the three-hour period on the daily report; also on the graphic chart posted on wall of engine room. Record manometer reading of liquid chlorine apparatus, as provided for on daily report sheet. Take temperature of No. 3 engine room daily, noon and midnight during winter months and record on weekly report.

Consider the Boiler Plant—The engineer on watch should always know exactly what boilers are in use; what, if any, are banked and held ready for emergency; whether or not any are out for cleaning; in short, have exact knowledge of the entire boiler plant. To this end it is a rule that each engineer, before taking his watch and before the preceding engineer has left, shall personally inspect conditions of both upper and lower batteries of boilers; and observe the conditions at every boiler, whether in use or out of use. If a boiler is banked, note the condition of the banked fire, the steam pressure, the height of water in gage glass, the coal supply in car, etc. If any of these are not right, have them corrected as soon as possible. If in the judgment of the engineer there are not enough boilers under steam to meet probable demands, he should report to the chief engineer or assistant chief, and if he cannot do this, he should have such changes made as seem necessary, or prudent. As a general rule, if the basin is in service and Stirling boiler is in use, one or more of the lower boilers should be under steam; in hot dry weather, with heavy pumpage, all the boilers not out for cleaning should be under steam.

Consider the Fireman—If any change in operation involves more steam use, such as putting additional engines in service, the fireman should receive ample and definite information in time to be prepared for such increase in steam consumption.

Fire-Alarm Reports, Etc.—A written report on the special blank is to be made of every fire alarm, showing time received, pressure, increased pump speed, etc. In addition, the office should be notified at 7 a.m. of all fire alarms received during the preceding night.

Record should be made daily on the weekly report by the engineer who receives the Gamewell alarm test at 12 noon. If test stroke does not come at 12 noon, the chief of the fire department should be notified at once.

During cold weather, when the automatic sprinkler pipes in exposed places are empty, the air pressure on same should be recorded twice daily on the weekly report.

Special for Chief Engineer

Sand Catchers—They are to be blown on the first day of each month and the conditions found are to be noted on daily and weekly report sheet.

Feed-Water Heater—The feed-water heater is to be cleaned about the 15th day of January, April, July and October, and the conditions found are to be noted on daily and weekly report sheets.

Cleaning Condensers No. 6 and No. 7—When the condensers are cleaned the time of cleaning and their conditions should be noted on the daily and weekly report sheets. When convenient the condenser should be tested for leakage

Indicator Cards—Indicator cards shall be taken about the fifth day of each month from engines No. 6 and No. 7. A set of cards should be sent to the office.

Coal—Coal cars shall be unloaded by day labor and a record of the cost kept.

River Soundings at Intake—Soundings in river bed along intake line and extending out to the opening in river should be taken each summer at low water and a profile made on basis of low-water mark.

Filter Manifolds—Two filter manifolds of each size shall be kept in stock.

Automatic Sprinklers—Thoroughly inspect automatic sprinklers at the station in November of each year and send written report to the office.

Boiler-Feed Pumps—These and the injector should be examined weekly and their condition reported.

Feed Water—Test feed water for soap hardness weekly and report same.

Evaporation Test of Boilers—Boilers to be tested monthly to determine evaporation per pound of coal; the Stirling and Battery No. 3 to be tested alternately.

Commercial stocks of bituminous coal in the United States on June 1, 1920, are estimated at 20,000,000 net tons. In the three months from March 1 to June 1, stocks decreased 4,000,000 tons, or 17 per cent. These estimates take into consideration coal in the hands of railroads, industrial consumers, public utilities and retail dealers. Information available concerning stocks of coal in the past is summarized in the following table:

TOTAL COMMERCIAL STOCKS OF BITUMINOUS COAL IN THE UNITED STATES OCT. 1, 1916 TO JUNE 1, 1920

(Net Tons)

Oct. 1, 1916	27,000,000	Jan. 1, 1919	57,900,000
Oct. 1, 1917	28,100,000	April 1, 1919	40,400,000
July 15, 1918	39,700,000	Mar. 1, 1920	24,000,000
Oct. 1, 1918	59,000,000	June 1, 1920	20,000,000
Day of the armistice, 63,000,000			

According to foreign trade figures of the United States Department of Commerce, exports of crude and refined oil for the fiscal year 1920 were nearly one-third as great as imports. Crude-oil imports amounted to 2,826,860,902 gal., of which Mexico sent over 2,825,000,000 gal. and Trinidad and Tobago more than 1,000,000 gal. Refined-oil imports totaled 81,888,904 gallons.

The Sixth National Chemical Exposition

The Sixth National Exposition of Chemical Industries opened its doors at the Grand Central Palace, Monday, Sept. 20, with the most interesting program and the biggest display of its kind ever seen.

Features of the exposition this year are the Fuel Economy and Materials Handling Symposium. These two divisions developed such progress that it was necessary to give each a separate section.

The official opening was held Monday evening. Dr. Charles H. Herty, chairman of the Advisory Committee, talked on the problems confronting the chemist and the progress made during the past five years. He was followed by Charles L. Reese and Sir George E. Foster, Canadian Minister of Trade and Finance.

On Tuesday afternoon the Fuel Economy Symposium was delivered. It included an address by the chairman, R. C. Beadle, managing editor of *Combustion*, and the following papers: "Burning Coal at 100 Per Cent B.t.u. Efficiency," W. O. Rankin; "Saving Fuel by Controlling Chimney Losses," F. F. Uehling; "Fluid Heat Transmission," Alexander B. McKechnie; "Producer Gas and the Modern Mechanical Producer," W. B. Chapman; "Refractory Cement—Life Insurance for a Furnace," F. W. Reisman; "Preventing Conduction and Radiation Heat Waste," S. L. Barnes, and "The Reason for the Fuel Saving in the Dressler Kiln," Conrad Dressler. In the evening motion pictures of interest to the chemical industry were shown.

Wednesday afternoon was devoted to the Industrial Management Symposium and the Materials Handling Symposium.

The Chemical Engineering Symposium was delivered on Thursday afternoon. In the evening a dinner of the American Institute of Chemical Engineers was held at the Technology Club. Friday was devoted to the ceramic symposium and in the evening motion pictures were shown.

The exposition closed on Saturday after a most successful week.

Thirty to Sixty Thousand Hp. Plants in the Mining Regions

Reasons for the establishment of a number of power plants of from 30,000 to 60,000 electric horsepower in the mining regions, rather than the building of larger plants at tidewater, are advanced by George S. Rice, the chief mining engineer of the Bureau of Mines. In discussing this matter, which is now being considered in connection with the Boston-Washington super-power plan, Mr. Rice said in part:

Power plants would not be located immediately at the mouth of a single mine, but rather at a point tributary to a group of mines, or where there is a large area of undeveloped coal in reserve. To carry the coal from the local mines to the near-by super-power station, there would need to be means of car transportation. Each super-power station, even if located in a coal district, should have coal-storage facilities adjacent, to contain at least a month's supply. Usually, however, it would be best to have coal hauled from the tipple and screening plant of the individual mine by open-top or bottom-dump railroad cars of standard type, and the cars hauled to the super-power station.

It may be pointed out that super-power stations located in the coal districts might have to be made smaller than super-power stations at tidewater points, on account of the limitations of condensing water in the former locations, so that there might be needed a larger number of smaller super-power stations, of 30,000 to 60,000 electric horsepower, but which would have a certain advantage in case of an accident or shutdown, from one cause or another, being of less importance than that of a super-power station of larger size.

Every consideration should be given to saving. One of the methods which would both effect a saving of such coal, and at the same time lessen the amount of water needed for a super-power station, would be through the further development of by-product coking plants, and the use of the gas from such plants in gas engines.

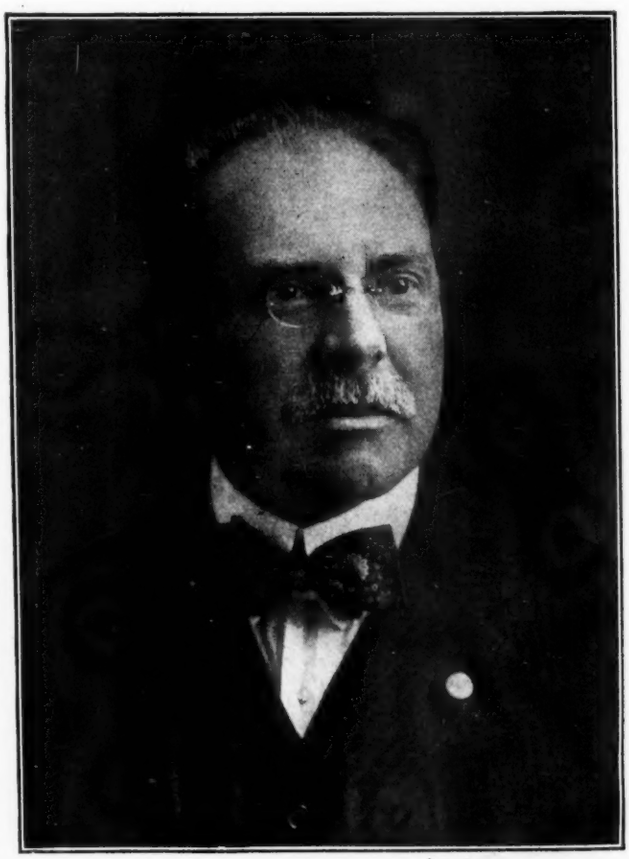
To locate super-power stations at tidewater will mean long railroad hauls over mountain grades, except on coal hauled from the anthracite fields, and distances by railroad of from 150 to 300 miles, and it means the hauling over railroads already crowded to capacity, and through congested terminals.

It seems evident from recent experience in securing fuel both in the East and the West, that it was not because of any shortage at the mine, but simply through lack of railroad capacity and any method that would lessen this difficulty should receive careful consideration.

DeLamater-Ericsson Memorial Tablets

At the annual convention of the American Society of Mechanical Engineers last December, a memorial meeting was held on the evening of Dec. 3 in commemoration of the eightieth anniversary of the arrival in the United States of Captain John Ericsson and his fifty years' association with Cornelius H. DeLamater in engineering work. In advance of the meeting it had been decided to erect memorial tablets to mark the sites of certain buildings which were closely identified with the work of DeLamater and Ericsson. It was proposed to erect four tablets as follows: One at the Phœnix Foundry at Laight and West Sts., New York City, where the first screw-propelled vessel in this country and the first steam fire engine were constructed and where many other original developments were made; one at Captain Ericsson's residence, 26 Beach St., where he designed the "Monitor" and made all his inventions during his later years; one at the DeLamater Iron Works at the foot of West Thirteenth St., where the engines of the monitors "Puritan" and "Dictator" were built, as well as the first submarine boat, the first torpedo boat, the first torpedo-boat destroyer, the first self-propelled torpedo, the first air compressors, the first ice machines, and many other industrial appliances now in general use; and one at the Continental Iron Works, Greenpoint, L. I., where the hulls of the "Monitor" and other warships were built.

Those wishing to contribute to the tablet fund are requested to communicate with the DeLamater-Ericsson Tablet Committee, H. F. J. Porter, chairman, Room 1100, Engineering Societies Building, 29 W. 39th St., New York City.



ALFRED JOHNSON
Recently Elected President, N. A. S. E.

Obituary

A. C. Buzby, president of the Keystone Lubricating Co., of Philadelphia, died suddenly on Tuesday, September 21. An extended obituary will appear in the Oct. 5, 1920 issue of *Power*.

William H. Tasker—On Aug. 17 funeral services for William H. Tasker, aged 71, for more than twenty years chief engineer at Symphony Hall, Back Bay, Boston, were conducted at his home, 11 Cedar Road, Medford Center, by Rev. A. Judson Hughes, pastor of the First Baptist Church of Everett. Delegations from Medford Lodge of Elks, the I. O. O. F. and the National Association of Stationary Engineers and of associates at Symphony Hall were in attendance. Mr. Tasker was a steam and electrical engineer well known throughout New England. The body was cremated and the ashes were buried in Pine Hill Cemetery, Dover, N. H., where Mr. Tasker was born and resided as a young man. He is survived by a widow, three sons and two brothers.

William M. Barr died recently after a long illness. He was born in 1842, in Muncy, Pa. He received the degree of mechanical engineering, to which profession he devoted his life. He served in the Navy throughout the Spanish and Civil Wars. He was well known in the world of technical literature for his works on "Pumping Machinery," "Boilers and Furnaces," "Combustion of Coal," etc. His chief work is "Barr's Industrial Engineering," a handbook of useful information for managers, engineers, superintendents, designers, draftsmen and others engaged in constructive work, Part I of which was recently issued. Part II is in preparation for early publication. Mr. Barr was a member of the American Society of Naval Engineers and the American Society of Mechanical Engineers.

Personals

A. A. Potter, Dean of Engineering at Kansas State Agricultural College since 1913, has assumed the same position at Purdue University.

A. W. Chesterton of the A. W. Chesterton Co., Boston, Mass., has lately returned from a business trip to Europe. One of the incidents of the visit was an aëroplane trip from London to Paris with his son as pilot.

O. L. Merket, who has been associated for the last 15 years with Westinghouse Church Kerr & Co., New York, has resigned and is now connected with the American Can Co. in the capacity of assistant chief engineer, with headquarters in New York City.

O. L. McIntyre has been transferred from the home office of the Fuller Engineering Co., Allentown, Pa., to Milwaukee, Wis., to superintend the erection of a 1,000-ton per day pulverized-coal installation at the Lakeside power plant of the Milwaukee Electric Railway and Light Co., for which the Fuller Engineering Co. has the contract.

Society Affairs

The American Electro-Chemical Society will hold its annual meeting in Cleveland, Ohio, Oct. 1 and 2.

The Technical National Section of the Prime Movers Committee will meet in Philadelphia on Oct. 18.

The Underground Systems Committee, Technical National Section, will meet in Pittsburgh, Nov. 11.

The National Association of Electrical Inspectors will hold their annual meeting in Philadelphia, Oct. 12-13.

Association of Railway Electrical Engineers will hold its annual meeting in Chicago from Oct. 28 to 30 inclusive.

The American Electric Railway Association will hold its annual convention at Atlantic City, N. J., Oct. 11 to 15 inclusive.

The Electric Power Club will hold its fall meeting at Hot Springs, Va., Nov. 15-18. Headquarters will be at the Homestead Hotel.

The Empire State Gas and Electric Association will hold its annual convention at Utica, New York, Oct. 7 and 8. Headquarters will be at the Hotel Utica.

The American Association of Engineers will hold its next regular meeting of the North Carolina State Assembly of A. A. E. (which is built around the North Carolina Society of Civil Engineers) in Raleigh next January.

The Inductive Interference Committee, Technical National Section, will hold a meeting in Salt Lake City, Utah, Nov. 15. The Technical National Section of the Prime Movers Committee will meet at the same time and place.

The Standardization Conference which is to be held at the Congress Hotel, Chicago, Ill., Oct. 9, has on its program a number of interesting papers. Among the problems which will come up for discussion is the present status of standardization of shafting sizes and the report of the Standardization Committee to the National Association.

The Engineering Society of Buffalo held a special meeting Sept. 21 at the University Club. The organization and aims of the Federated American Engineering Societies, to which the Buffalo society had been invited to become a member, were discussed. The meeting was addressed by Dexter S. Kimball and Richard L. Humphrey. The officers of the society for the year 1920-1921 are: W. B. Powell, president; C. G. Derick, vice-president; W. L. Spaulding, secretary; W. M. Dollar, treasurer. Directors representing affiliated sections are David Childs (A.C.S.), W. A. Kidd (A.I.A.), W. J. Gamble, Jr. (A.S.M.E.), David Bell (A.S.T.S.), E. T. Larkin (S.A.E.) and A. H. Hooper (A.E.S.).

The Federal Department of the American Association of Engineers has announced the appointment of the following engineers as members of the Federal Department Council: Morris Bien, assistant director of the Reclamation Service, Washington; N. S. Thompson, chief of the electro-mechanical division, supervising architect's office, Washington; H. E. Hallborg, radio engineer, Norfolk Navy Yard, Norfolk, Va.; William B. Harrison, of the United States Engineers' office, Washington; W. C. Dean, chief of the electrical division, Bureau of Construction and Repair, Washington; W. A. E. Doying, inspecting engineer of the Panama Canal, Washington; W. C. Lemen, of the United States Engineers' office, New York; J. T. Maguire, project manager, Bureau of Yards and Docks, Washington.

Miscellaneous News

Production of the Electrical Manufacturing Industry during 1919 was about $900,000,000, of which over $90,000,000, or 10 per cent, was exported. This is an increase of 50 per cent in exports since 1918, when we exported only $60,000,000 worth of electrical products.

The Alabama Power Co., Birmingham, is arranging an extensive construction program to include the erection of a number of power plants and extensions to existing generating stations. A hydro-electric plant will be built at Judkins Riffle on the Coosa River, at a cost of $10,000,000.

Business Items

The Industrial Heating & Engineering Co. announces the removal of the business to 385 Windsor St., East Akron, Ohio.

The Jeffrey Manufacturing Co., Columbus, Ohio, has opened a new branch office in Buffalo, N. Y., in the Marine Trust Building. H. W. Scott, formrly in charge of the home office, will manage the new branch.

Trade Catalogs

Consolidated Wire and Machinery Corporation, of Chicago, dealers in used electrical equipment is sending out a stock sheet of the loose-leaf variety assembled within a 4 x 6¾-in. paper binder. Full data and the price of the equipment, including generators, motors, transformers, regulators, remote control devices, etc., are given, and monthly lists follow for insertion to keep the stock record up to date.

Warren Webster & Company, of Camden, New Jersey, has just issued a new bound volume containing a number of catalog bulletins of feed-water heaters, oil separators, steam separators and other apparatus handled by the company. Each article is described in a most complete manner and is clearly illustrated by photographs and line drawings. Installations of feed-water heaters are shown and described. A description of construction and operation is also given. This booklet should prove instructive and interesting to power-plant engineers. A copy can be obtained on request.

New Construction

PROPOSED WORK

N. H., Manchester—I. W. Dickey, R. F. D. No. 5, is in the market for a 15 hp. gasolene engine.

Mass., Boston—Coolidge & Shattuck, Archts., 122 Ames Bldg., will soon receive bids for a 12 story office building including a steam heating system on Beacon and Somerset Sts. About $500,000. Owner's name withheld.

Mass., East Boston (Boston P. O.)—The City Schoolhouse Dept. is having plans prepared for a 3 story school including a steam heating system in the Samuel Adams Dist. About $250,000. C. G. Loring, 7 Water St., Boston, Archt.

Mass., Peabody—The School Comn. will receive bids until October 1 for a 2 story high school including a steam heating system on Central St. About $500,000. F. I. Cooper Corp., 33 Cornhill St., Boston, Archt.

R I., Newport—The Bd. Educ. will soon receive bids for a 3 story, 110 x 150 ft. high school including a steam heating system on Bway. About $600,000. B. H. Seabury, 21 Besse Pl., Springfield, Mass., Archt.

Conn., New Britain—The Bd. Educ. will soon award the contract for a 2 story, 60 x 240 ft. school including a steam heating system on Tremont St. About $350,000. Deebert K. Perry, 27 West Main St., Archt.

Conn., West Hartford—The Bd. Educ. rejected all bids for a 2 story, 200 x 210 ft. high school including a steam heating system on South Main St. About $500,000. W. T. Marchant, 36 Pearl St., Hartford, Archt. Work will be readvertised. Noted August 3.

N. Y., Buffalo—The Lambert Press, 813 Seneca St., is in the market for a generator and electrical welding equipment and tools.

N. Y., Jamestown—I. S. Burns, Secy. of the Bd. of Park and City Planning Comrs., is preparing plans for repairing the heating and lighting system at the Fenton Homestead here. About $25,000.

N. Y., Marcy—The State Hospital Comn., Capitol, Albany, will receive bids until October 6 for the construction of tunnels and conduits and heating work for service connections, etc., at the Utica State Hospital, here.

N. Y., New York—Carlson & Wiseman, Archts. and Engrs., 226 Henry St., Brooklyn, are preparing plans for a 2 story theatre including a steam heating system on Bway. and Hamilton Pl. About $500,000. Owner's name withheld.

Pa., Allentown—Malcolm W. Gross, Mayor, Central Fire and Police Station, will receive bids until October 11 for furnishing and installing one 750 hp. steam turbine, with reduction gears, one 12,000,000 gal. centrifugal pumping unit, one 500 hp. a.c. motor and one 3 stage, 7,000,000 gal. centrifugal pump, etc., at the pumping station.

Pa., Harrisburg—Henry W. Gough, Dauphin Co. Controller, will receive bids until October 1 for the installation of an atmospheric steam heating system in the Courthouse.

Va., Richmond—W. S. Eubank, 2506 East Broad St., is in the market for an air compressor.

Va., Richmond—F. F. Hough, c/o Realty Finance Co., 108 North 8th St., is in the market for 1 electric motor, 1 gasoline engine (new or used).

Fla., Jacksonville — The United States Engineer will receive bids until October 15 for constructing and installing 4 Scotch marine boilers, oil bunkers, etc.

La., New Orleans—The McComb Ice Factory, McComb, Miss., is in the market for two 150 hp. horizontal tubular boilers. (Used preferred.) X. A. Kramer, Copartner.

Ind., Indianapolis—The Bd. of School Comrs., Meriden and Ohio Sts., will receive bids until October 1 for a 2 or 3 story, 250 x 400 ft. shop building for school on East Michigan St. Plans include the installation of a power house, boilers, stokers, coal ash handling equipment, etc. About $225,000. Snider & Rotz, 703 Merchants Bank Bldg., Engrs. D. A. Bohlen & Son, Majestic Bldg., Archts.

O., Bryan—The Central Light & Power Co. plans to build a power plant.

O., Cleveland—The Bd. Educ. will receive bids until October 11 for a 1 story sewage treatment and water pumping plant. About $50,000. L. H. Geiss, Clk. C. W. Bates, Natl. Bank Bldg., Wheeling, West Va., Archt.

O., Cleveland—The Brotherhood of Locomotive Engineers, c/o Warren S. Stone, Engineers' Bldg., plans to build a 20 story bank and office building including a steam heating system on St. Claire Ave. and Ontario St. About $5,000,000. Knox & Elliott, 1248 Rockefeller Bldg., Archts.

O., Toledo—The Maumee Tire & Rubber Co., 705 Madison Ave., is having plans prepared for a 3 story, 100 x 300 ft. rubber tire factory on Lackey Rd. Boilers will be installed in same. About $300,000. Osborn Eng. Co., 2848 Prospect Ave., Cleveland, Archt. and Engr.

Mich., Lansing—Walter E. Boose is having plans prepared for an 8 story, 190 x 230 ft. hotel including a steam heating boiler and equipment. T. E. White, City Natl. Bank Bldg., Archt.

Mich., Muskegon—H. H. Turner, Archt., 923 Michigan Trust Bldg., Grand Rapids, will receive bids until October 1 for a 3 story high school including a steam heating system on Denmark Ave., for the Bd. Educ. About $250,000.

Ill., Noble—The Bd. Educ. will soon award the contract for a high school, including a steam heating and ventilation system.

Wis., Fond du Lac—The Bd. Educ. will soon award the contract for a 3 story, 66 x 261 ft. senior and junior high school including a steam heating system, motors, etc. About $500,000. A. M. Hunter, Secy. Childs & Smith, East Van Buren St., Chicago, Ill., Archts.

Wis., Fond du Lac—The Fountain City Ice Cream Co., 218 South Main St., is having plans prepared for a 2 story, 60 x 180 ft. dairy plant on Division St. A refrigeration system will be installed in same. About $80,000. B. E. Mehner, Archt.

Wis., Hartford—The city plans to build a 60 x 155 ft. power house on Main St. Estimated cost, $50,000. W. Radke, City Clk. A. H. Martin, Engr.

Wis., Neillsville—Herman North is having plans prepared for a 3 story, 70 x 170 ft. hotel including a steam heating system on Main St.

Wish., Sheboygan—The Northern Furniture Co., South Water St. and New Jersey Ave., is having preliminary plans prepared for a 4 story, 60 x 250 ft. office building and power house on South Water St. About $200,000. W. C. Weeks, 730 Ontario Ave., Archt. and Engr.

Ia., Crystal Lake — F. A. Gabrielson, Secy., will soon award the contract for the heating, plumbing and electrical work in school for the Consolidated Independent School Dist.

Ia., Mason City—The Mason City Hotel Co., c/o C. H. McNider, plans to build an 8 story, 142 x 167 ft. hotel including a steam heating system on South Federal St. About $1,000,000. Proudfoot, Bird & Rawson, 810 Hubbell Bldg., Des Moines, Archts.

Minn., Madelia—The city plans to install pumping equipment in connection with the proposed waterworks system. About $12,000. John W. Shaffer, 501 New York Life Bldg., Minneapolis, Engr.

Minn., Minneapolis—The Hennepin Minneapolis Knights of Columbus No. 435, 428 South 8th St., had preliminary plans prepared for a 3 story club house including a steam heating system. About $500,000. E. J. Loring, Grand Knight.

Kan., Osawatomie—The city is having plans prepared for the installation of an addition to the present power plant and a dam to impound 60,000 gals. About $85,000. Black & Veatch, Mutual Bldg., Kansas City, Engrs.

Kan., Topeka—The city plans an election November 3 to vote on $460,000 bonds to build a filtration plant and pumping station. Black & Veatch, Mutual Bldg., Kansas City, Mo., Engrs.

S. D., Aberdeen—The Y. M. C. A. plans to build a 3 story Y. M. C. A. building including a steam heating system. About $225,000. R. C. Bell, Secy.

N. D., Ashley—John Hildenbrand, Aud. of McIntosh Co., will receive bids until October 19 for the installation of electric light equipment including a 20 hp. oil or gasolene engine, 1 fuel tank, one 12½ kw. generator, switchboard, etc., in the Court House.

Mo., Liberty—The town is having plans prepared for a pumping plant. C. E. Jacoly, 528 Shubert Bldg., Kansas City, Engr.

Okla., Spiro—The city plans an election November 4 to vote on $40,000 for an addition to pumping plant. H. G. Olmsted & Co., Oklahoma City, Engr.

Tex., Dallas—A. H. Woods Enterprises, 236 West 42nd St., New York City, plans to build a theatre including a steam heating system on Griffin St. About $500,000. W. Wellman, Supt.

Tex., Wichita Falls—The State Bd. of Control, Austin, will receive bids until October 4 for the installation of a heating and plumbing system, refrigeration plant, etc., in the Northwest Texas Insane Asylum, here.

Cal., Cantara (Shasta Springs P. O.)—The Sacramento Klamath Water, Land & Power Co., Salem, Ore., through Victor De Marais and Charles E. Watson of Sacramento, has applied to the State Engr., for permission to divert 4,000 sec.ft. of water from the Klamath River for the purpose of irrigating 250,000 acres of land and developing 150,000 hp. Plans include a dam, headgate and power plant here. About $15,000,000.

N. B., St. John—The New Brunswick Electric Power Comn. will soon award the contract for earth dams across the East branch of the Musquash River, in connection with the development of the power projects at Shogomoc and Musquash. About $150,000. Reid McManus, Canada Bldg., Secy. C. O. Foss, Engr. Noted Sept. 21.

Ont., Windsor — Colthurst Trace & Nickols, Archts., 16 Sanwich St., West, will receive bids about January 1 for a 2 story, 120 x 400 ft. cold storage plant. About $600,000. Owner's name withheld.

CONTRACTS AWARDED

Conn., Montville—Robert Gair, 50 Washington St., Brooklyn, New York City, has awarded the contract for a 2 story, 200 x 500 ft. manufacturing building and a 1 story, 50 x 50 ft. power plant, to Barney Ahlers, 110 West 40th St., New York City. Incorrectly noted in August 31 issue.

R. I., Providence—The Providence Biltmore Hotel Co., 217 Hospital St. Trust Bldg., has awarded the contract for a 19 story hotel including a steam heating system on Dorrance, Eddy and Washington Sts., to Thompson Starrett Co., 49 Wall St., New York City. About $300,000.

N. J., Jersey City—The Hespe Realty Co., Central Ave., will build a theatre on Central Ave. Estimated cost, $250,000. Work will be done by day labor.

N. J., West Orange—The Edison Electric Co. has awarded the contract for a boiler house, to the Amer. Concrete Steel Co., 27 Clinton St., at $100,000.

Pa., Philadelphia—The Orinoka Mills, Ruth St., has awarded the contract for a 1 story, 50 x 117 ft. boiler and power house on Sterner and Jasper Sts., to the Wilson Ruff Co., Franklin Trust Bldg., at $100,000.

Pa. Tabor (Philadelphia P. O.)—The Fox Motor Car Co., Broad and Huntington Sts., has awarded the contract for a 3 story, 60 x 400 ft. automobile plant including a steam heating system on Grange Ave. along the Reading R.R., to J. S. Rogers, 970 Drexel Bldg., at $500,000.

O., Cincinnati—S. and L. Shubert, Inc., 225 West 44th St., New York City, has awarded the contract for a theatre including a steam heating system to Ed. Margolies, 19 East 33rd St., New York City, at $500,000.

Ill., Rockford—The town has awarded the contract for the installation of a pumping station, to Ross P. Beckstrom & Co., at $88,121.

Wis., Sheboygan—The Tomah Rubber Co., 176 16th St., Milwaukee, has awarded the contract for remodeling old plant and constructing two 70 x 100 ft. units on Lymans Ave., here, to H. Loesing, 914 Superior Ave., at $35,000. A steam heating system and electric power will be installed in same.

Ia., Cherokee—The State Bd. of Control, Des Moines, has awarded the contract for a pump house, pump pit, and reservoir, to Rhodes & Christianson, Guthrie. Noted July 13.

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